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MARINE ZOOLOGY OF TROPICAL CENTRAL PACIFIC

By

Charles Howard Edmondson,
W. K. Fisher,
Hubert Lyman Clark,
A. L. Treadwell,
Joseph Augustus Cushman.

Bernice P. Bishop Museum
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TANAGER EXPEDITION
Publication No. 1

Honolulu, Hawaii
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PREFACE

At conferences in Washington and at Pearl Harbor, in 1922, participated in by the United States Navy, the National Research Council, the United States Biological Survey, and Bernice P. Bishop Museum, plans were formulated for a scientific survey of the thirteen islands of the Hawaiian group extending northeast from Kauai to Ocean Island and also of Johnston and Wake islands. As a result of these conferences the Tanager Expedition of 1923-24 was organized under the following cooperative agreement: that the Navy Department should provide a suitable vessel (the minesweeper "Tanager") and assume responsibility of charting hydrographic data; that the United States Biological Survey should provide the services of an ornithologist, a specialist in the destruction of rabbits, and a moving picture operator; that the Bishop Museum should provide such other personnel as might be considered desirable; that Commander S. W. King should direct the activities of the Navy involved in the joint undertaking; and that Dr. Alexander Wetmore should be placed in charge of the scientific field parties.

Four trips were made during 1923 and one in 1924. On the first trip, the "Tanager" visited Laysan, Ocean, Green, Midway, Pearl and Hermes Reef, and two new islands hitherto uncharted. On the second trip, surveys were made at Laysan, Lisiansky, Gardner, and Nihoa islands. On the third trip, the investigations covered Necker and Nihoa islands and French Frigate Shoals. A circuit of Kaula Island was made. On the fourth trip, the "Tanager," augmented by the destroyers "Burns" and "Ludlow" and the minesweeper "Whippoorwill," carried a scientific party to Wake and Johnston islands. At the request of the National Research Council, the Navy Department, acting through Rear Admiral John D. McDonald, Commandant at Pearl Harbor, again provided the "Tanager" for a resurvey of Necker and Nihoa.

The scientific parties of 1923 included: Alexander Wetmore, ornithologist, chief of parties; Edward L. Caum, James B. Pollock, Gerrit P. Wilder, botanists; David T. Fullaway and Edwin H. Bryan, entomologists; Frank R. Lawrence, C. Grant, and Donald R. Dickey, naturalists and photographers; C. Montague Cooke, Jr., Lorrin A. Thurston, David Thaanum, Theodore T. Dranga, conchologists; C. H. Edmondson, zoologist; Harold S. Palmer, geologist; J. B. Mann, topographer; Bruce Cartwright and A. L. C. Atkinson, archaeologists; John W. Thompson, preparator;

C. S. Judd, forester; E. C. Reno, specialist in the destruction of rabbits; Arthur C. Rice, Orme Cheatham, Max Schlemner, Jr., Austin Jones, John Baker, and W. G. Anderson, collectors and assistants.

For 1924, the scientific personnel consisted of Harold S. Palmer, geologist and chief of party; Kenneth P. Emory, ethnologist; Erling Christophersen, botanist; Theodore T. Dranga, conchologist; A. Landgraf, topographer; and William G. Anderson, William Bush, Kenneth I. Hanson, and George Kimball, assistants and collectors. (For detailed statements of itinerary and of field work accomplished by the Tanager Expedition, see Annual Report of the Director for 1923 and for 1924: B. P. Bishop Mus. Bull. 10, 1924 and Bull. 21, 1925.)

Marine Zoology of Tropical Central Pacific

CRUSTACEA

By

CHARLES HOWARD EDMONDSON

INTRODUCTION

The taxonomic section of this paper is limited to a treatment of crustaceans collected during the cruise of the "Tanager" from April 4, 1923, to August 13, 1923. It is an attempt to supplement and extend knowledge of the distribution of the crustacean fauna of the Pacific.

A few species apparently new to science are described and a considerable number of new records for the North Pacific Ocean are listed. The known crustacean fauna of the leeward Hawaiian islands, at least as far to the westward as Laysan Island, considerably exceeds that listed here. While more than 60 species were collected by the Tanager Expedition at Laysan Island alone, but ten of them are represented in the list of 25 reported from that locality by Lenz (15),[1] and many of the species taken by the "Albatross" in 1902 were not duplicated by the Tanager Expedition.

All but two of the thirteen species of crustaceans reported from Wake Island by Dana (7) are included in the list of more than a hundred collected in that locality by the Expedition of 1923. The naturalists of the United States Exploring Expedition, while ashore at Wake Island, apparently did not observe the large land hermit crab, *Coenobita olivera* Owen, which is one of the most abundant and conspicuous members of the land fauna of the island today. It is possible that the species may have immigrated to the island subsequently to 1841.

The shore and shallow water crustacean fauna of the leeward islands of Hawaii is, for the most part, identical with that of the larger islands of the group. The survey of the Tanager Expedition clearly shows that a number of species distributed throughout Hawaii are much more abundant about some of the outlying islands of the leeward chain. *Carpilodes super-*

[1] Numbers in parenthesis refer to Bibliography at end of each paper.

nodosus Rathbun, present but not common on the reefs of Oahu and others of the larger islands, is one of the most abundant of the shallow water species about French Frigate Shoals, Lisiansky, and Laysan islands. *Phymodius laysani* Rathbun, occasionally taken on the reefs of Oahu, is apparently very common at Ocean Island and appeared at all of the leeward reefs except Lisiansky. It is also very abundant in the shallow waters about Johnston Island. Though I have but three records of *Platypodia actoeoides* (A. M. Edwards) having been taken from the reefs of the larger islands of Hawaii, it is widely distributed through the leeward chain of islands and is well represented in numbers at Laysan and Ocean islands. One specimen was also taken at Wake Island.

Johnston Island clearly represents a transitional zone between the marine forms of the South Pacific and those of Hawaii. Its crustacean fauna, however, is predominately Hawaiian, fully ninety per cent of the species taken at Johnston Island being common in the shallow waters of Hawaii.

The similarity of the crustacean fauna of Wake Island, more than two thousand miles to the westward, to that of Hawaii is not so marked as that of Johnston Island. About seventy-five per cent of the species taken at Wake Island during the Tanager Expedition have been previously recorded or observed in Hawaiian waters.

I am indebted to Dr. Mary J. Rathbun and to Dr. Waldo L. Schmitt of the United States National Museum, and to Dr. C. B. Wilson of the State Normal School, Westfield, Massachusetts, for assistance in the determination of certain species listed in this report. Included in the systematic part of this paper is the description of a new species of hermit crab by Otto Degener, the type locality of which is the island of Oahu but which also appeared in the area covered by the Tanager Expedition.

TAXONOMY

Order DECAPODA

Suborder NATANTIA

Tribe PENEIDES

Family SERGESTIDAE

Sergestes atlanticus Milne Edwards.

Sergestes frissii Kroyer, Kgl. Denske Vid. Selsk. Skrifter, 5. Raekke, Naturv.-math. Afd. IV, 2, p. 235, Tab. 1, fig. 1, a-v, 1859.

Sergestes atlanticus Hansen, The Sergestidae of the Siboga Expedition, monog. 38, p. 8, 1919.

Three specimens were taken from the surface at night a few miles southwest of Wake Island. The species has a very extensive range having been reported from numerous stations in the Atlantic, Indian, and Pacific oceans. Hansen states that it is a species of the open seas and of surface waters.

Lucifer typus Milne Edwards.

Lucifer typus Hansen, The Sergestidae of the Siboga Expedition, monog. 38, p. 53, pl. 4, figs. 6a-6k, 1919.

One male specimen with long eye-stalks evidently belonging to this species, due to characteristics of the petisma and telson, was taken in the surface tow at night a few miles southwest of Wake Island. Ten female specimens also with long eye-stalks and taken at the same locality may possibly be of this species.

Hansen distinguishes between *L. typus* and his new species, *L. orientalis,* and calls attention to the unreliable reports of the distribution of *L. typus* as previously recorded by authors. He believes that, due to confusion of descriptions of species under the title *L. reynaudii,* this name should be dropped.

L. typus has been reported from the Atlantic Ocean and was taken by the Siboga at a few stations in the East Indian seas but according to Hansen, *L. orientalis* is much more common in the region explored by the Siboga than is *L. typus.*

A re-examination of the species which I listed from Fanning Island in 1923 (9, p. 35), under the name *L. reynaudii* Milne Edwards, leads me to believe, without doubt, that it is *L. faxonii* Borradaile.

Family PENEIDAE

Penaeus marginatus Randall.

Penaeus marginatus Rathbun, U. S. Fish Comm. Bull., vol. 23, pt. 3, p. 902, pl. 19, fig. 2, and text fig. 55, 1906.

One specimen was taken at French Frigate Shoals. The species is very common in the shallow waters about Oahu and is nearly always to be

found in the Honolulu fish markets. The "Albatross" collected it at many stations in the Hawaiian islands.

Tribe CARIDES

Family HIPPOLYTIDAE

Hippolysmata paucidens Rathbun.

Hippolysmata paucidens Rathbun, U. S. Fish. Comm. Bull., vol. 23, pt. 3, p. 913, pl. 24, fig. 4, 1906.

The Tanager Expedition collected from Lisiansky, French Frigate Shoals, Laysan and Johnston islands, ten specimens in all. It is very common on the reefs about Oahu.

Saron marmoratus (Olivier).

Saron marmoratus Kemp. Indian Mus. Rec., vol. 10, p. 84, 1914.

The species was taken at French Frigate Shoals, Johnston and Wake islands, 12 specimens in all. This species, widely distributed through the Indian and Pacific oceans, is not uncommon in the shallow waters about the larger islands of Hawaii.

Thor maldivensis Borradaile.

Thor maldivensis Borradaile, Linn. Soc. London Trans., vol. 17, p. 401, pl. 58, fig. 6, 1917.

Eight specimens were collected at Wake Island. Borradaile records the species from the Maldives, Minikoi, and Salomon Island in the Indian Ocean. It has also been taken on Waikiki reef, Oahu.

Family RHYNCHOCINETIDAE

Rhynchocinetes rugulosus Stimpson.

Rhynchocinetes rugulosus Rathbun, U. S. Fish Comm. Bull., vol. 23, pt. 3, p. 911, text fig. 64, 1906.

One specimen was taken at Laysan Island. The "Albatross" collected a specimen at French Frigate Shoals in about 17 fathoms. Stimpson reported the species from Port Jackson, Australia.

Family PONTONIIDAE

Harpiliopsis depressus (Stimpson).

Harpilius depressus Stimpson, Acad. Nat. Sci. Phila. Proc., p. 38, 1860.

Forty-three specimens were collected at Ocean, Laysan, Johnston and Wake islands. The species has previously been recorded from the Red Sea, the Indian Ocean, Palmyra Island, and the Hawaiian islands. It is a common species on the reefs of Oahu.

Harpiliopsis beaupresi (Audouin).

Harpiliopsis beaupresi Borradaile, Linn. Soc. London, Trans., vol. 26, no. 8, p. 379, pl. 55, fig. 21, 1917.

Two specimens were collected at French Frigate Shoals. Previous records of the species include the Red Sea and localities in the eastern section of the Indian Ocean.

Coralliocaris tridentata Miers.[2]

Coralliocaris tridentata Miers, Zoological Collections of H. M. S. "Alert," Crust., p. 294, pl. 32, fig. C, 1884.

Three specimens were taken at Pearl and Hermes reefs. Previous records of the species are from Thursday and Palmyra islands.

Coralliocaris lucina Nobili.

Coralliocaris lucina Nobili, Mus. Univ. Napoli. Ann. n. s., 1, no. 3, p. 5, 1901: Kemp, Indian Museum, Rec., vol. 24, pt. 2, p. 276, 1922.

Thirty-two specimens were collected at Johnston and Wake islands, the species being about equally common in the two localities. It is widely distributed in the Indian Ocean, and has previously been reported from Palmyra Island in the North Pacific Ocean.

Coralliocaris quadridentata Rathbun.

Coralliocaris quadridentata Rathbun, U. S. Fish. Comm. Bull., vol. 23, pt. 3, p. 920, pl. 24, fig. 1, text fig. 69, 1906.

Eight specimens were taken at Johnston Island. Rathbun reports one specimen taken from Auau Channel, between Maui and Molokai, at depths from 28 to 43 fathoms.

Coralliocaris graminea (Dana).

Oedipus gramineus Dana, U. S. Expl. Exped., vol. 13, Crust., p. 574, 1852; pl. 37, fig. 3, 1855.

This species is represented in the "Tanager" collections by 31 specimens, 5 taken at Johnston Island, and 26 at Wake Island. It is widely distributed through the Indian and Pacific oceans. There are records of this species in the Bishop Museum from Palmyra Island but none from Hawaii.

Pontonia quadratophthalma Balss.

Pontonia quadratophthalma Balss, Results of Dr. E. Mjoberg's Swedish Scientific Expeditions to Australia 1910-13, XXIX, Stomatopoda, Macrura, Paguridae and Galatheidea: Kungl. Svenska Vetenskapsakademiens Handlingar. Band 61, no. 10, p. 15, fig. 7, 1921.

One specimen was collected at Pearl and Hermes Reef, and one at Wake Island. The type locality is Cape Jaubert, Northwest Australia.

[2] Renamed *C. rathbuni* by Borradaile (4, vol. 17, pt. 3, p. 385, 1917).

Periclimenes (Falciger) spiniferus de Man.

Periclimenes (Falciger) spiniferus Borradaile, Linn. Soc., London, Trans., vol. 6, no. 8, p. 369, pl. 52, fig. 1, 1917.

Twelve specimens were taken at Wake Island. Previous records are from the Indian Ocean, the East Indies, Samoa and Tahiti.

Conchodytes meleagrinae Peters.

Pontonia meleagrinae Bate, Voyage of the "Challenger," vol. 24, p. 707, pl. 124, figs. 1, 2, 1888.

Conchodytes meleagrinae Borradaile, Linn. Soc., London, Trans., vol. 6, p. 393, pl. 57, fig. 26, 1917.

Five specimens were taken at French Frigate Shoals, the data of four of them reading "In a live pearl shell." Borradaile says regarding the distribution of the species "Indopacific, in *Meleagrina,* and occasionally in *Tridacna.*"

Palaemonella orientalis Dana.

Palaemonella orientalis Dana, U. S. Expl. Exped., vol. 13, Crust., p. 583, 1852; pl. 38, fig. 4, 1855.

An imperfect specimen, taken at Pearl and Hermes Reef, apparently belongs to this species. The species was reported by Dana from the Sulu Sea.

Palaemonella rathbunensis Borradaile.

Palaemonella orientalis Rathbun, U. S. Fish Comm. Bull., vol. 23, pt. 3, p. 925, 1906.

One specimen which agrees with this species, renamed by Borradaile (4, vol. 17, pt. 3, p. 357, 1917), was collected at Wake Island. Rathbun described the species from Hawaii.

Palaemonella tenuipes Dana.

Palaemonella tenuipes Dana. U. S. Expl. Exped., vol. 13, Crust., p. 582, 1852; pl. 38, fig. 3 a-d, 1855.

One specimen was taken at Johnston Island and 12 were taken at Wake Island. The species is known to range from the Red Sea to Japan, and has been recorded in the Pacific from the Liu Kiu islands, New Guinea, Funafuti, Palmyra and Hawaii.

Family GNATHOPHYLLIDAE

Gnathophyllum fasciolatum Stimpson.

Gnathophyllum fasciolatum Stimpson: Acad. Nat. Sci. Phila. Proc., p. 28, 1860.

Five specimens were collected at Wake Island and one at Johnston Island. The species ranges from Mauritius through the Indian and Pacific oceans to Tahiti and northward to Hawaii. If *G. americanum* Guérin is identical with this species, as some authorities believe, its distribution would include the Gulf of Mexico and the waters about Cuba and Porto Rico.

Family CRANGONIDAE

Automate gardineri Coutière.

Automate gardineri Coutière: Mus. Hist. Nat. Bull., vol. 8 p. 337, 1902; Fauna and Geogr. Maldive and Laccadive Archipelagoes, vol. 2, p. 854, text figs. 127, 128, 1906.

One specimen was taken at Wake Island. The species is known from Kingsmill Island in the Pacific, and from the Maldive Archipelago, Djibouti and Muscat in the Indian Ocean.

Automate dolichognatha de Man.

Automate dolichognatha de Man, Arch. für Naturgesch. vol. 53, p. 529, pl. 22, fig. 5, 1887; Lanchester, Zool. Soc. London, Proc. (2), p. 564, pl. 34, fig. 3, 1901.

Six specimens were collected at Wake Island. It has previously been reported from numerous localities in the Indian Ocean.

Athanas djiboutensis Coutière.

Athanas djiboutensis Coutière, Museum d'Hist. Nat. Bull., vol. 6, p. 233, 1897; Fauna and Geogr. Maldive and Laccadive Archipelagoes, vol. 2, p. 856, text fig. 129, 1902.

One specimen was collected at Wake Island. The species has been recorded from Djibouti, the type locality, and also from the eastern Indian Ocean. In the South Pacific it has been reported from Funafuti.

Synalpheus paraneomeris Coutière.

Synalpheus paraneomeris Coutière, Fauna and Georg. Maldive and Laccadive Archipelagoes, vol. 2, p. 872, pl. 71, fig. 7, 1906.

Thirty-two specimens in all were collected from Pearl and Hermes Reef, French Frigate Shoals, Lisiansky, Johnston, and Wake islands. Previous records include stations in the Indian Ocean and Palmyra Island in the North Pacific.

Synalpheus charon (Heller).

Alpheus charon Heller, Sitz. Akad. Wien, Bd. 44, 1, p. 272, pl. 3, figs. 21 and 22, 1862.

Twenty-five specimens were collected at Laysan Island. Previous records are from the Indian Ocean, Hongkong, Japan, Thursday Island, and Australia.

Synalpheus macromanus, new species. (Fig. 1, *a-j.*)

Holotype, a female; length, from anterior tip of rostrum to posterior extremity of telson, 13½ mm. Type locality, Lisiansky Island. Bishop Museum collections No. 1801.

A Synalpheus of the Neomeris group with dactylus of third, fourth and fifth legs biunguiculate, the merus of third legs unarmed and the upper angle of basicerite without a spine, truncate. These characters, together with the ventral hook of the dactylus of the third leg, relates this species

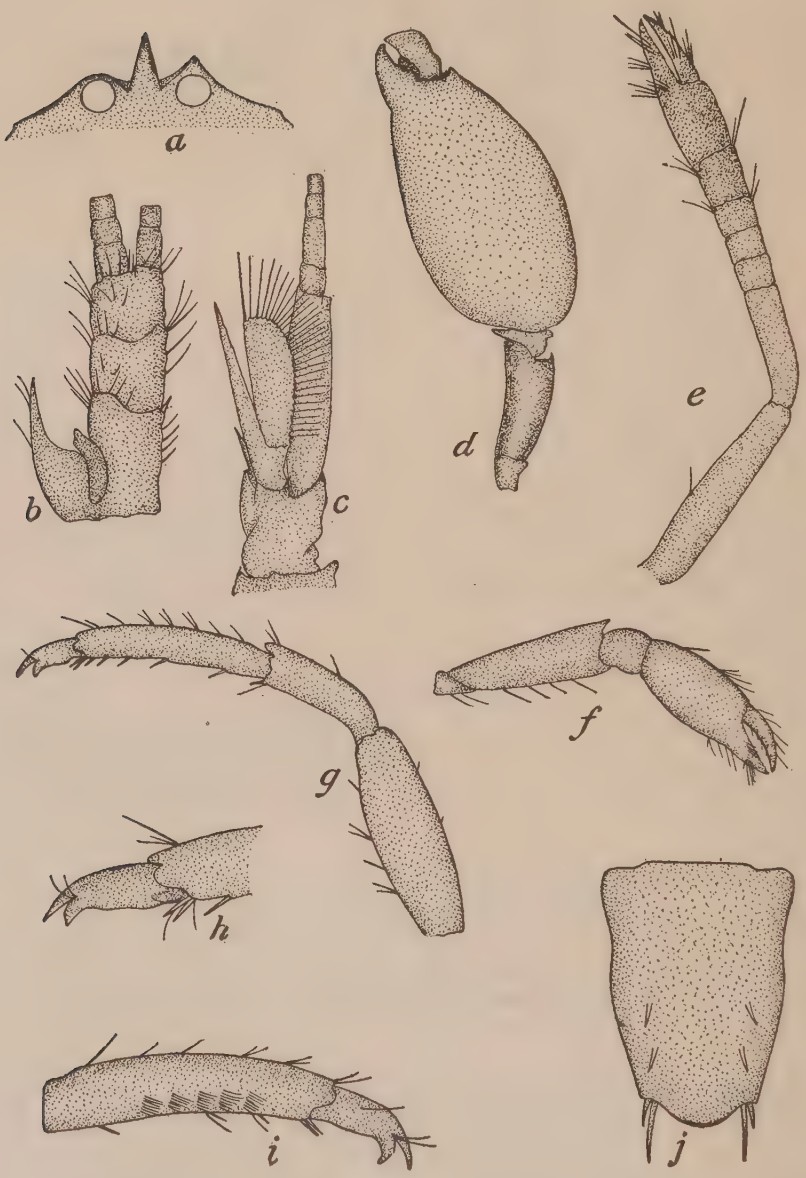

FIGURE 1. *Synalpheus macromanus,* new species: *a,* front border of carapace (border asymmetrical in holotype); *b,* basal segments of left antennule; *c,* basal segments of left antenna; *d,* left cheliped; *e,* second leg, left side; *f,* right cheliped; *g,* third leg, left side; *h,* end of third leg; *i,* terminal segments of fifth leg, right side; *j,* telson (feathered bristles of posterior border not shown).

to *Synalpheus charon* (Heller) (17) and *Synalpheus helleri* de Man (21, p. 194) from each of which, however, it differs in certain well defined features.

Rostrum triangular, sharp pointed, length ½ mm., width at base one-half the length, extending forward to the distal extremity of basal segment of antennule and without carina (fig. 1, *a*). Orbital hood drawn forward into an acute point extending half the length of the rostrum, slightly bent downward.

Antennular peduncle (fig. 1, *b*) with sharp, prominent stylocerite. Basicerite with lower spine reaching just beyond the distal extremity of the first segment of the antennular peduncle, upper margin truncate without a spine. Spine of scaphocerite straight on outer border, equal in length to the carpocerite and extending slightly beyond the distal extremity of the blade. Spine of scaphocerite extends a little beyond the distal extremity of the third segment of the antennular peduncle and the blade falls slightly short of the distal extremity of the same segment.

Telson similar in shape to that of *Synalpheus paraneomeris* Coutière (15, p. 872, pl. 71, fig. 7), 1 mm. long, slightly longer than broad at base; posterior border strongly convex; postero-lateral angles sharp but not spinous; two pairs of movable spines on the dorsal surface, both of which are posterior of the middle (fig. 1, *j*).

Left cheliped (fig. 1, *d*) the larger; merus twice as long as broad, triangular in cross section, upper border sharp, terminating distally in a small sharp tooth, lower distal angles more obtuse; carpus short and wide. Chela large, inflated, ovate; length of palm a little less than twice its greatest diameter, smooth and unarmed; fingers short, heavy, sharp pointed, immovable one as deep at base as long. Right cheliped (fig. 1, *f*) very small compared with left; merus twice as long as broad, upper border sharp, terminating distally in a sharp tooth; carpus as long as wide; palm compressed, a little longer than fingers; fingers elongate, slightly curved, sharp pointed, each with sharp cutting edge, movable one with blunt tooth at base. Tufts of setae are on the borders of right cheliped, the fingers are well covered with them.

Second leg (fig. 1, *e*) with first segment of carpus five times as long as the second, second and third equal, fourth slightly shorter than third, fifth a little longer than second and third combined, and stouter; fingers and palm subequal, the former covered with tufts of setae. Length of merus of third leg (fig. 1, *g*) three times its greatest width, smooth, unarmed, with a few tufts of setae on lower border; upper distal border of carpus terminating in a blunt process and lower distal extremity armed with a movable spine; propodus slightly shorter than merus, armed with a series of five movable spines on the lower border and a pair of them at the distal extremity, upper border with tufts of setae. Dactylus with upper hook slender, sharp, lower hook shorter, thick at the base and acutely pointed (fig. 1, *h*).

Fourth leg similar to third except shorter and more slender; propodus with one less spine on lower border. Fifth leg (fig. 1, *i*) similar to fourth in size and length with one less spine on lower border of propodus; five series of comb-like spinules arranged diagonally on the lower posterior surface of the middle third of the propodus. Lower hook of dactylus in fourth and fifth legs less acutely pointed than in third leg.

Crangon collumianus (Stimpson).

Alpheus collumianus Stimpson, Acad. Nat. Sci. Phila., Proc., 1860, p. 30.

Thirty-eight specimens in all were collected at Ocean Island, Pearl and Hermes Reef, Lisiansky, Laysan, Johnston, and Wake islands. The species has a wide distribution through the Indian and Pacific oceans. It has frequently been taken on the reefs of Oahu.

Crangon ventrosus (Milne Edwards).

Alpheus ventrosus Milne Edwards, Hist. Nat. Crust., vol. 2, p. 352, 1837.

Twenty-three specimens in all were taken at French Frigate Shoals, Laysan, Johnston, and Wake islands. This species is the most common of the genus and is very generally distributed throughout the Indian and Pacific Oceans.

Crangon paragracilis (Coutière).

Alpheus paragracilis Coutière, Mus. d'Hist. Nat. Bull., vol. 3, p. 304, 1897; Fauna and Geogr. Maldive and Laccadive Archipelagoes, vol. 2, p. 883, pl. 71, fig. 22, 1906.

One hundred and forty specimens were collected by the Tanager Expedition at Pearl and Hermes Reef, French Frigate Shoals, Ocean, Laysan, Lisiansky, Johnston, and Wake islands. Its previously recognized range was from Madagascar through the Indian Ocean and included Murray Island and Tahiti in the South Pacific. It has also been taken on the reefs of the larger islands of Hawaii.

Crangon gracilis (Heller).

Alpheus gracilis Heller, SB. Akad. Wien, vol. 44, p. 271, 1862.

Fifteen specimens were collected at Lisiansky, Laysan, and Johnston islands. Previous records include the Red Sea and Djibouti in the Indian Ocean.

Crangon insignis (Heller).

Alpheus insignis Heller, Sitz. Wiss. Wien, vol. 44, p. 269, pl. 3, fig. 17-18, 1862.

Thirteen specimens in all were collected at Pearl and Hermes Reef, Lisiansky, Laysan, and Johnston islands. The species is known from the Red Sea, the Indian Ocean, the Malay Archipelago and Samoa. It has frequently been taken on the reefs of Oahu.

Crangon paracrinitus (Miers).

Alpheus paracrinitus Miers, Ann. and Mag. Nat. Hist. (5), vol. 8, p. 365, pl. 16, fig. 6, 1881.

One specimen was taken at Laysan Island and 19 at Johnston Island. At Johnston Island it was apparently one of the most common species of the genus. Previous records include Senegambia and Djibouti, Indian Ocean localities, and Palmyra Island in the North Pacific.

Crangon paracrinitus, var. **bengalensis** (Coutière).

Alpheus paracrinitus, var. *Bengalensis* Coutière, Fauna and Geogr. Maldive and Laccadive Archipelagoes, vol. 2, p. 901, 1906.

Six specimens which correspond closely to this variety were collected at Wake Island. The record of Coutière is from Minikoi. I reported a close affinity of the variety from Palmyra Island in 1923 (10).

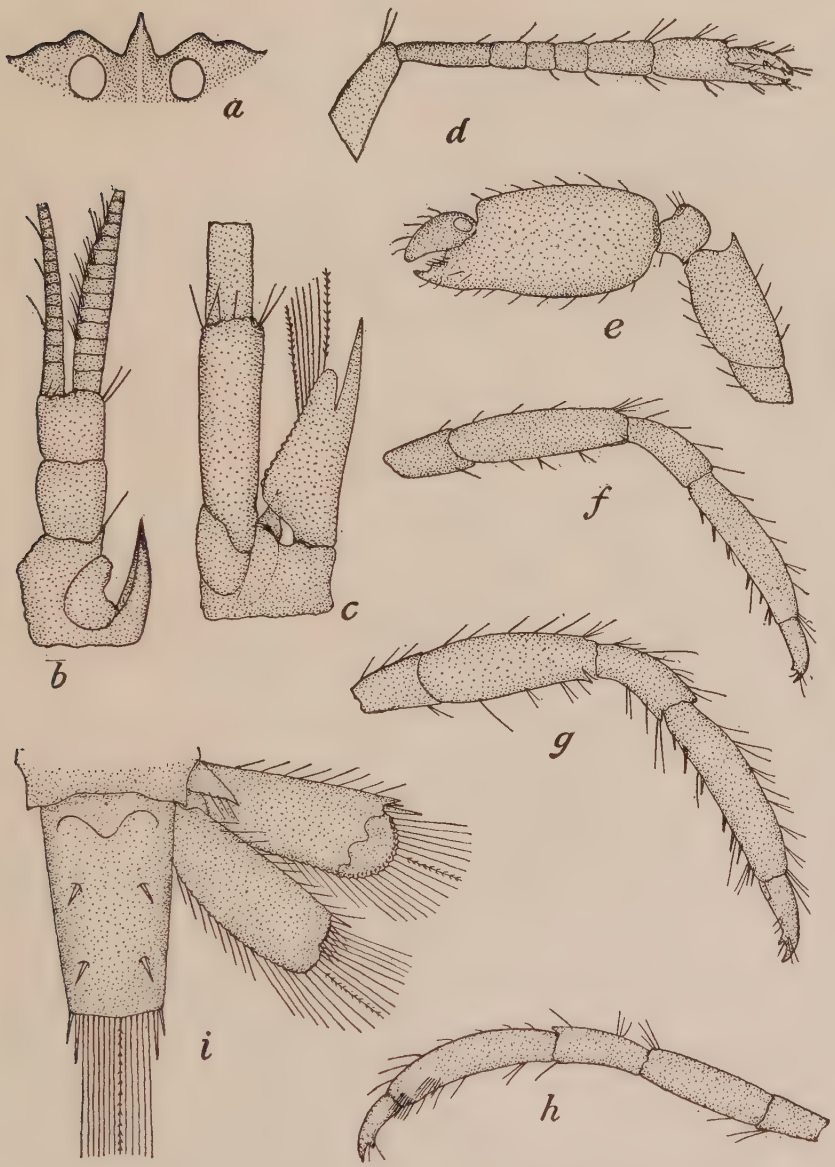

FIGURE 2. *Crangon hawaiiensis,* new species: *a,* front border of carapace; *b,* basal segments of right antennule; *c,* basal segments of right antenna; *d,* second leg, right side; *e,* left cheliped; *f,* third leg, right side; *g,* fourth leg, right side; *h,* fifth leg, left side; *i,* telson and right uropod.

Crangon bucephalus (Coutière).

Alpheus bucephalus Coutière, Fauna and Geogr. Maldive and Laccadive Archipelagoes, vol. 2, p. 890, pl. 78, fig. 29, 1906.

Two specimens were taken at Johnston Island and one at Laysan Island. The species has been recorded from the Indian Ocean, Ceylon, off Manila, and from Palmyra Island.

Crangon hawaiiensis, new species. (Fig. 2, *a-i.*)

Holotype, a female; length, from tip of rostrum to posterior extremity of telson, 12 mm. Type locality, Lisiansky Island, shallow water. Bishop Museum collections No. 1802.

Although this species is somewhat Synalpheus-like in appearance, the thoracic appendages bear epipods, therefore it must be considered a true Crangon. It apparently belongs to the Macrochirus group of the genus, and seems to be near *Crangon paragracilis* (Coutière) (15, p. 883, pl. 71, fig. 22), which it resembles in the rostral border and the biunguiculate character of the dactyli of the three posterior legs, but differs from that species in the large cheliped and in the merus of the third and fourth legs.

Rostrum sharp, longer than its width at the base, bearing two setae on each lateral border. Front margin of orbital hoods extending forward in blunt lobes to a level with half the length of the rostrum; upper border of rostrum rounded, separated from the orbits by shallow depressions (fig. 2, *a*).

Antennular peduncle with a sharp, prominent stylocerite which reaches just beyond the distal extremity of the first segment (fig. 2, *b*). Basicerite bearing a strong ventral spine; distal point of spine of scaphocerite on a level with the distal extremity of carpocerite, the latter extending slightly beyond the distal extremity of the antennular peduncle (fig. 2, *c*).

Telson 1.5 mm. long, posterior border nearly straight, more than three-fourths the greatest width of telson (fig. 2, *i*).

Left cheliped (fig. 2, *e*) the larger, merus three-fifths as broad as long, compressed, outer surface convex, inner surface slightly concave, upper and lower borders thin; upper border nearly straight, terminating distally in a sharp tooth, lower border more convex; carpus as broad as long; palm of chela compressed, one and a half times as long as broad, upper and lower borders rounded, smooth and free of notches and grooves but for a shallow concavity in the lower border just posterior to the base of the immovable finger; movable finger strong and blunt with a blunt tooth at its base. The borders of the cheliped, fingers and inner surface of palm provided with long setae, arranged singly and in tufts.

Second leg slender, first segment of carpus two and a half times as long as the second, third and fourth segments equal, fifth twice as long as the fourth; palm and fingers subequal in length (fig. 2, *d*). In third and fourth legs (fig. 2, *f, g*) ischium and merus without movable spines, but a sharp tooth is at the distal extremity of the lower border of the merus. This tooth is very small in the third leg, much stronger in the fourth leg. A few setae are on the borders of the ischium and merus. Carpus unarmed but bordered with a few long setae. Propodus almost twice as long as carpus, lower border with a series of immovable spines, there being six such spines in the third leg and seven in the fourth leg. In both legs accessory spinules or long setae accompany the movable spines. Upper border of propodus in both third and fourth legs provided with strong setae, singly and in tufts. Dactylus stout, one-third the length of the propodus, with a strong accessory tooth near the tip.

Fifth leg (fig. 2, *h*) more slender and slightly shorter than fourth; ischium, merus and carpus without spines but with a few strong setae. Propodus without

movable spines but with two rows of strong setae placed diagonally on the ventro-lateral border near the distal extremity, the more distal of the two rows being the longer and having longer setae. Dactylus with a strong accessory tooth.

Crangon clypeatus (Coutière).

Alpheus clypeatus Coutière, Fauna and geogr. Maldive and Laccadive archipelagoes, vol. 2, p. 897, pls. 81 and 82, fig. 36, 1906.

Fifty specimens in all were collected at Ocean Island, Pearl and Hermes Reef, French Frigate Shoals, Johnston, and Wake islands. It is a common species in nearly all of these localities.

Crangon pachychirus (Stimpson).

Alpheus pachychirus Stimpson, Acad. Nat. Sci. Phila. Proc., p. 30, 1860.

One specimen was taken at Wake Island. Previous records are from the Maldive and Laccadive archipelagoes, Japan, the Liu Kiu islands, Murray Island, Rotuma, and Palmyra Island.

Crangon pacificus (Dana).

Alpheus pacificus Dana, U. S. Expl. Exped., vol. 13, Crust., p. 542, 1852; pl. 34, fig. 5, 1855.

Eight specimens in all were taken at Ocean, Laysan, and Wake islands. The species is widely distributed through the Indian and Pacific oceans.

Crangon crassimanus (Heller).

Alpheus crassimanus Heller, Reise der Novara, Crust., p. 107, pl. 10, fig. 2, 1865.

Fourteen specimens in all were collected at Lisiansky, Laysan, and Johnston islands. The type locality is the Nicobar Islands. It was taken at Cape York, Australia, by the Challenger Expedition, and has been collected on the reefs of Oahu.

Crangon leviusculus (Dana).

Alpheus edwardsii var. *leviusculus* Dana, U. S. Expl. Exped., vol. 13, Crust., p. 543, 1852; pl. 34, fig. 8, 1855.

Ten specimens were taken at Johnston Island and seven at Wake Island, the latter being the type locality. It was collected at Kur Island, East Indies, by the Siboga Expedition.

Crangon gracilipes (Stimpson).

Alpheus gracilipes Stimpson, Acad. Nat. Sci. Phila. Proc., p. 31, 1860.

Two specimens were collected at Lisiansky Island. The species has a wide range from Djibouti through the Indian and Pacific oceans to Tahiti and Hawaii, including New Caledonia, Australia, and Samoa in the south Pacific.

Crangon deuteropus (Hilgendorf).

Alpheus deuteropus Hilgendorf, Monatsb. K. AK. Wiss. Berlin, p. 839, pl. 4, figs. 8-19, 1878: Coutière, Fauna and Geogr. Maldive and Laccadive Archipelagoes, vol. 2, p. 880, 1906.

Four specimens were collected at French Frigate Shoals. The species

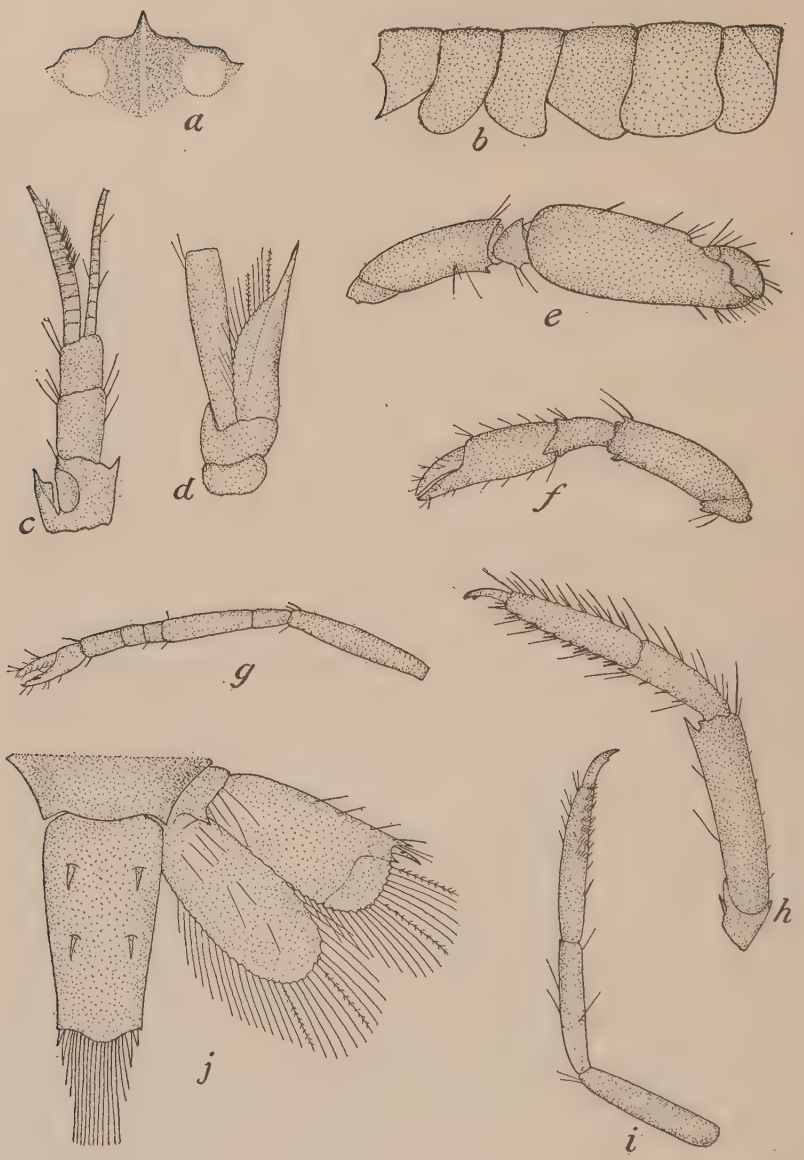

FIGURE 3. *Crangon laysani,* new species: *a,* front border of carapace; *b,* lateral view of first six abdominal segments; *c,* left antennule; *d,* basal segments of right antenna; *e,* right cheliped; *f,* left cheliped; *g,* second leg, left side; *h,* third leg, left side; *i,* fifth leg, right side; *j,* telson and right uropod.

has previously been reported from widely separated localities, including Zanzibar, Djibouti, Obok, Perim, the Maldive Archipelago, and Tague Island.

Crangon laysani, new species. (Fig. 3, *a-j.*)

Holotype, a female; length, from anterior tip of rostrum to posterior margin of telson, 12 mm. Type locality, Laysan Island, shallow water. Bishop Museum collections No. 1803.

This apparently new species is clearly within the Crinitus subgroup of the Crinitus group, according to the classification of Coutière. It resembles *Crangon alcyone* (de Man) (21, p. 351) and *Crangon providencei* (Coutière) (6, p. 18) in having the dactyli of the three posterior legs biunguiculate, and in the absence of spines from the middle of the posterior margin of the sixth abdominal segment. It differs, however, from *C. alcyone* in having the posterior border of the merus of the third leg devoid of movable spines, and from *C. providencei* in a relatively longer second segment of the carpus of the second leg.

Front border of carapace (fig. 3, *a*) somewhat like *C. eulimene* (de Man) (21, p. 364) and *C. superciliaris* (Coutière) (6, a, p. 896, pl. 81, fig. 35) with a short, sharp rostrum and the frontal margin extending transversely outward from the base of the rostrum and separated by distinct emarginations from the orbital hoods. Rostrum extending anteriorly to the distal border of the first segment of the antennular peduncle, its width at the base equal to its length. A sharp rostral carina extends posteriorly beyond the border of the orbits and is separated from them by shallow depressions.

Basal segment of antennular peduncle with a short stylocerite not reaching to distal extremity of the segment, and its medial distal border terminating in a sharp spine (fig. 3, *c*).

Basicerite apparently unarmed; spine of scaphocerite extending slightly beyond the distal extremity of the carpocerite; blade of scaphocerite narrow, not quite reaching the distal extremity of the antennular peduncle, while the carpocerite extends slightly beyond it.

General shape of telson (fig. 3, *j*) like that of *C. eulimene* (21, p. 364); length 2 mm., greatest breadth 1mm. Of the two pairs of spinules on the dorsal surface of the telson, the posterior pair is situated nearly one-half the length from the posterior border, the anterior pair being approximately one-fourth the length of the telson from the anterior border. Posterior border of telson with a pair of spines unequal in length, near each lateral angle, and fringed with about 20 feathered setae. Uropods are also fringed with feathered setae.

Right cheliped (fig. 3, *e*) in type specimen the larger. Merus twice as long as broad, sharp above and below, terminating distally in an acute tooth above and a subterminal sharp tooth below. Chela cylindrical-ovoid, smooth; length of palm 3 mm., greatest width 1.5 mm.; length of movable finger 1.5 mm., blunt with an acute tooth directed posteriorly at base. Merus of smaller cheliped nearly three times as long as wide, a blunt, subterminal point marking the upper, distal border and a strong, sharp, subterminal tooth the corresponding lower border. Carpus two-fifths as long as merus. Chela with palm slightly longer than fingers which are blade-like, sharp pointed. Palm and fingers covered by tufts of setae (fig. 3, *f*).

Second leg slender; second segment of carpus three times as long as the first, third segment as long as the fourth, fifth one and one-half times the length of the fourth; fingers longer than the palm (fig. 3, *g*).

Third (fig. 3, *h*) and fourth legs resembling those of *C. consobrinus* (de Man) (21, p. 360), except for being biunguiculate. Ischium with a strong movable spine; merus about four times as long as broad with a few short setae on upper border, and longer setae at distal extremity of this border; lower border with a few long

setae and a strong, sharp, subterminal tooth. Carpus a little more than half as long as merus, with numerous long setae on upper border, three movable spines and a few long setae on lower border; lower distal extremity terminating in a straight, sharp tooth; propodus one and one-third times as long as carpus, with tufts of strong setae on upper border, and a series of strong movable spines with smaller spinules and long setae beside them on the lower border. On the propodus of the third leg the movable spines are eight in number and on the fourth leg seven; dactylus a little more than one-fifth as long as propodus with a small but distinct accessory tooth.

Fifth leg more slender than the fourth; merus and carpus unarmed but provided with a few setae; propodus with a series of seven rows of fine setae diagonally placed on the distal half of the lower inner border; a few long setae on the upper border and six movable spines on the lower border; dactylus with a distinct accessory tooth (fig. 3, *i*).

Suborder REPTANTIA

Tribe PALINURA

Family PALINURIDAE

Panulirus pencillatus (Olivier).

Panulirus penicillatus Bate, Voyage of the Challenger, vol. 24, p. 82, pl. 12, fig. 2, 1888.

Three specimens in all were collected, one at each of the following localities: Laysan, Johnston, and Wake islands. The species is widely distributed through the Indian and Pacific oceans.

Panulirus japonicus (von Siebold).

Palinurus japonicus de Haan, Fauna Japon., Crust., p. 158, pls. 41 and 42, 1841.

Two specimens were taken at Laysan Island. The typical species ranges from Japan to Hawaii, while several recognized varieties are widely distributed through the Indian Ocean.

Family SCYLLARIDAE

Parribacus ursus major (Herbst).

Parribacus antarcticus Dana, U. S. Expl. Exped., vol. 13, Crust., p. 517, 1852; pl. 32, fig. 6, 1855.

Parribacus ursus major de Man, Decapoda of the Siboga Expedition, pt. 3, monog. 39a,[2] p. 93, 1916.

Three specimens in all were taken at French Frigate Shoals, Laysan, and Johnston islands. The species which is well distributed through the Indo-Pacific region ranges from Mauritius to Tahiti and Hawaii. It also occurs in the Caribbean Sea and on the shores of Brazil.

Pseudibacus pfefferi Miers.

Pseudibacus pfefferi Miers, Zool. Soc. London Proc., 1882, p. 542, pl. 36, figs. 2, 3.

One specimen, which is tentatively placed under the specific name proposed by Miers, was collected on the Tanager Expedition at French Frigate Shoals. According to de Man it is the opinion of Bouvier that this form may be the natant stage of *Scyllarides squammosus* (Milne Edwards)

(13, p. 284). It has previously been reported from Mauritius and the Galapagos Islands. The type specimen from Mauritius was 32 mm. long. There is in the Bishop Museum a specimen 30 mm. long from Kaaawa, Oahu, of the same species and of about the same size as that taken by the Tanager Expedition, and another specimen 50 mm. long from Hauula, Oahu. A careful comparison of this larger specimen with the adult *Scyllarides squammosus,* which occurs in Hawaiian waters, leads one to support Bouvier in his belief. The question can only be determined, however, by a complete knowledge of the life history of *S. squammosus.*

Tribe ANOMURA

Family HIPPIDAE

Remipes pacificus Dana.

Remipes pacificus Dana, U. S. Expl. Exped., vol. 13, Crust., p. 407, 1852; pl. 25, fig. 7 a-g, 1855.

Eight specimens in all were taken at Lisiansky Island and French Frigate Shoals. The species has a wide range, being reported from the Indian Ocean and many localities in the Pacific. It is common about the shores of Oahu.

Family PORCELLANIDAE

Petrolisthes speciosus (Dana).

Porcellana speciosa Dana, U. S. Expl. Exped., vol. 13, Crust., p. 417, 1852; pl. 26, fig. 8, 1855.

The only record of this species in the Tanager collections is from Wake Island. Thirty-five specimens were taken from that locality. The species seems to range from the Indian Ocean to Japan and eastward to the Tuamotus. There are no records from Hawaii. It has, however, been taken at Palmyra Island and is very common at Fanning Island. Rathbun has reported the species from the west African coast.

Petrolisthes coccineus (Owen).

Porcellana coccinea Dana, U. S. Expl. Exped., vol. 13, Crust., p. 423, 1852.

One specimen was collected at Necker Island. The type locality is the Tuamotus. Dana records the species from Maui and there are two specimens in the Bishop Museum from Oahu. It has also been reported from the Nicobar Islands.

Pachycheles pisoides (Heller).

Porcellana pisoides Heller, Reise der Novara, Crust., p. 73, pl. 6, fig. 3, 1865.

One specimen was taken at French Frigate Shoals. The type locality is the Nicobar Islands. It has been found to be a common species on Waikiki reef, Oahu.

Family GALATHEIDAE

Galathea spinosorostris Dana.

Galathea spinosorostris Dana, U. S. Expl. Exped., vol. 13, Crust, p. 480, 1852; pl. 30, fig. 9 a-c, 1855.

Five specimens in all were collected at French Frigate Shoals, Pearl and Hermes Reef and Laysan Island. Dana's record is from Hawaii. It has been taken at Waikiki, Oahu, both on the reef and at depths from 30-50 fathoms outside the reef. There is a specimen in the Bishop Museum from Samoa.

Galathea integrirostris Dana.

Galathea integrirostris Dana, U. S. Expl. Exped., vol. 13, Crust., p. 482, 1852; pl. 30, fig. 12, a-b, 1855.

Two specimens were collected at Laysan Island. The species seems to be confined to the Hawaiian group. Dana's specimen was dredged at Lahaina, Maui. I do not know of other records of the species.

Family AXIIDAE

Axiopsis (Paraxiopsis) johnstoni, new species. (Fig. 4, *a-f*; Pl. I, A.)

Holotype, a female, measuring 12 mm. from anterior tip of rostrum to posterior extremity of telson. Type locality, Johnston Island. Bishop Museum collections No. 1804.

This apparently new species is of the genus Axiopsis as defined by Borradaile, and possesses certain features corresponding to the subgenus Paraxiopsis of de Man. It seems to be near *Axiopsis* (*Paraxiopsis*) *brocki* (de Man) (20, p. 475, pl. 20, figs. 3, 3a-3d), but differs from that species in characters of the rostrum, chelipeds and telson.

Rostrum on a lower level than the gastric region of the carapace and directed slightly downward (fig. 4, *a*); gastric region gradually sloping anteriorly to the rostrum except in the mid-line where it is sharply deflected by reason of a short keel-like anterior prolongation of the gastric region of the carapace. Acute tip of rostrum reaching almost to the extremity of the middle segment of the antennular peduncle. Rostrum concave on upper surface, rounded below; lateral borders of rostrum marked by three teeth and tufts of hairs. From basal teeth of the lateral borders of the rostrum slight ridges curve backward on the gastric region of the carapace (fig. 4, *b*). The "thorns" of the antennal peduncle are very short, there being a stout tooth at the ventral, distal extremity of the third segment, and a very short, movable acicle on the upper distal extremity of the same segment (fig. 4, *c*). The antennular peduncle is unarmed; flagellum as long as the carapace.

Surface and lateral borders of carapace and first five abdominal segments smooth and free from hairs; sixth abdominal segment with two tufts of long setae extending backward from the posterior margin and overlying the telson. Telson a little longer than broad, sides nearly parallel, slightly broader at proximal end; each lateral border with two short teeth. Posterior border of telson convex in mid-region, toothed at lateral corners, just medial of which on either side is a pair of movable spines, the inner one being the longer; posterior border of telson fringed with long setae (fig. 4, *f*).

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Dorsal surface of telson without spines but rendered irregular by three papillate elevations which give rise to tufts of long setae. One of the three elevations occupies the mid-line region proximal of the middle, the other two, broad and ridge-like, are about the middle of the telson one on either side of the mid-line.

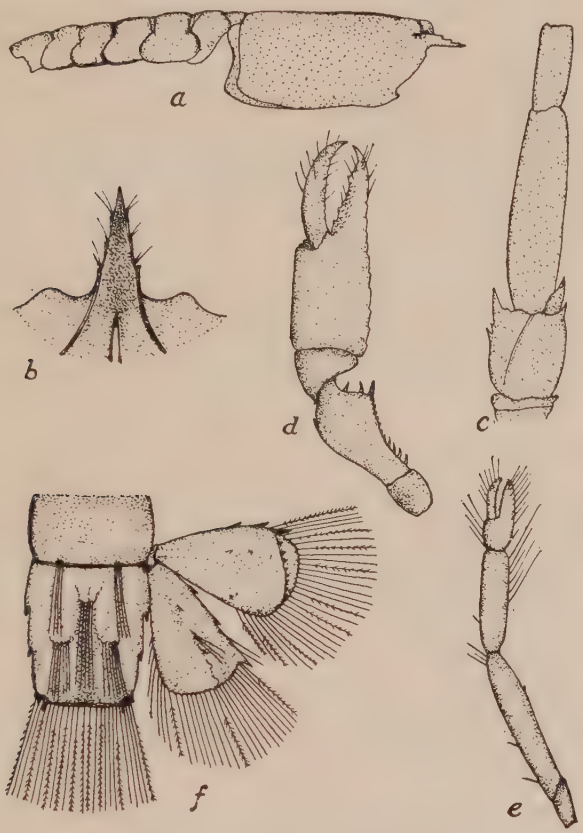

FIGURE 4. *Axiopsis* (*Paraxiopsis*) *johnstoni*, new species: *a*, lateral view of carapace and first six abdominal segments; *b*, rostrum and front border of carapace; *c*, basal segments of left antenna; *d*, right cheliped; *e*, second leg; *f*, telson and right uropod.

The front margin of both endopodite and exopodite of uropod is provided with three teeth increasing in length distally, the teeth being closer together on the margin of the exopodite. The transverse suture of the exopodite is also bordered by fine teeth, and the borders of both exopodite and endopodite are fringed with long setae some of which, on the exopodite, are of large size. Endopodite is traversed longitudinally near the mid-line by a ridge which is accentuated by tubercles giving rise to tufts of setae, and by one or two sharp spines. The uropod is slightly longer than the telson.

Length of merus of chelipeds about twice its greatest width, narrow proximally, broadened and inflated distally, inner surface flattened, outer surface convex, both smooth; upper and lower borders narrow with low, rounded crests; lower border armed

proximally with a series of four sharp teeth curving forward, becoming serrations in the middle region; lower distal border armed with strong sharp teeth, three in the right merus and two in the left. Upper border of merus with a small subterminal tooth near the distal extremity. A few long setae are on both upper and lower borders.

Wrist short, smooth, with a few scattered hairs on the surface. The hand of the right cheliped (fig. 4, *d*), including fingers, is slightly longer than the left, but the left is a little stouter. In each the palm is slightly longer than broad, compressed, more convex on the outer surface, smooth; upper border rounded, lower border with strong serrations which continue on the lower edge of the immovable finger, being more pronounced in the left hand. Fingers of right hand as long as upper border of palm, strongly curved, sharp pointed, crossing at tips when closed and both slightly curved inward. Movable finger with basal portion longitudinally furrowed and inconspicuous serrations along the cutting edge; immovable finger toothed at the proximal end and near the tip of the cutting edge.

Fingers of the left hand shorter than the palm and stouter than those of the right hand and more strongly curved inward. There is a low, blunt tooth proximal of the middle of the cutting edge in the movable finger, while the immovable finger has a strong bluntly-rounded tooth near the distal extremity of its cutting edge, and a much smaller one near the middle. The inner surface of the palm, and the borders and surfaces of the fingers in both chelipeds are provided with scattered tufts of hairs.

Second leg (fig. 4, *e*) with merus six times as long as broad, smooth, with a tooth on its lower border distal of the middle; propodus slightly more than half as long as merus, smooth; fingers longer than palm, broad, curved inward, cutting edges finely toothed. Third leg absent beyond the merus which is six times as long as broad, smooth and unarmed but for an inconspicuous blunt tooth at the distal extremity of the lower border. Fourth leg absent in type specimen. Fifth leg very slender, distal extremity of propodus reaching to distal extremity of merus of third leg when both are extended; propodus slightly longer than merus and twice as long as carpus; dactylus slightly curved, with three teeth, increasing in length distally, on the lower border and a small, subterminal one on the upper border. A few setae along the borders of the merus and carpus become numerous toward the upper and lower distal extremities of the propodus, on the lower border of which is also a long movable spinule. A few setae also are scattered along the borders of the dactylus.

Coenobita oliviera Dana, U. S. Expl. Exped., vol. 13, Crust., p. 470, 1852.

Family COENOBITIDAE

Coenobita oliviera Owen.

The only locality included in the Tanager Expedition where this land hermit occurs is Wake Island. It is very abundant there, commonly inhabiting shells of Turbo. The Bishop Museum has 60 specimens from that island. The species is widely distributed in the Indian and South Pacific oceans. In the North Pacific it has been recorded from Guam, Marcus, Palmyra, and Fanning islands. It does not occur in Hawaii.

Coenobita rugosa (Milne Edwards).

Coenobita rugosa Dana, U. S. Expl. Exped., vol. 13, Crust., p. 471, 1852; pl. 30, fig. 1, 1855.

Ten specimens were collected at Wake Island, the only locality covered by the Tanager Expedition where the species occurs. It is a widely dis-

tributed species in the Indian and South Pacific oceans. Previous records from the North Pacific include the Bonin Islands, Guam, Palmyra, and Fanning islands. It inhabits the shells of many species of mollusks and may be found on the ocean beaches just above high tide line. There are no records from Hawaii and Dana did not report it from Wake Island in 1841.

Family PAGURIDAE

Clibinarius corallinus (Milne Edwards).

Clibanarius corallinus Alcock, Cat. Indian Decapod Crust., pt. 2, fasc. 1, p. 48, pl. 5, 1905.

The species was collected by the Tanager Expedition at Wake Island only, where 39 specimens were taken. It is very common in that locality. The previously known range extended through the eastern Indian Ocean, the Malay Archipelago, and eastward through the Pacific to Tahiti and northward to Fanning Island. It has not been recorded from Hawaii.

Calcinus herbstii de Man.

Calcinus herbstii Alcock, Cat. Indian Decapod Crust., pt. 2, fasc. 1, p. 53, pl. 5, fig. 4, 1905.

On the Tanager Expedition 10 specimens were taken at Nihoa, 57 at Johnston Island, and 12 at Wake Island. The species ranges through the warmer waters of the Pacific and Indian oceans. Is also reported from the West Indies and Ecuador. It is very common on the reefs of Oahu but was not taken by the Expedition about any of the low, leeward islands of the Hawaiian chain.

Calcinus elegans (Milne Edwards).

Calcinus elegans Alcock, Cat. Indian Decapod Crust., pt. 2, fasc. 1, p. 55, pl. 5, fig. 2, 1905.

Twenty specimens in all were collected at French Frigate Shoals, Necker, Johnston and Wake islands. The species is widely distributed through the Indian and Pacific oceans.

Calcinus latens Randall.

Calcinus latens Alcock, Cat. Indian Decapod Crust., pt. 2, fasc. 1, p. 58, pl. 5, fig. 5, 1905.

On the Tanager Expedition survey 132 specimens in all were collected at French Frigate Shoals, Pearl and Hermes Reef, Ocean, Johnston, and Wake islands. Of this number 114 were taken at Johnston Island where the species was apparently the most common of the hermit crabs of the shore waters. The species has a wide range through the Indian and Pacific oceans. It is common about Oahu, and there are records of the species from Laysan Island.

Aniculus aniculus Fabricius.

Aniculus aniculus Alcock, Cat. Indian Decapod Crust., pt. 2, fasc. 1, p. 94, pl. 7, fig. 6, 1905.

Aniculus typicus Dana, U. S. Expl. Exped., vol. 13, Crust., p. 461, 1852; pl. 29, fig. 1, 1855.

Forty-one specimens in all were collected by the Tanager Expedition at Johnston and Wake islands, the species being common in both localities. It ranges through the Indian Ocean and the Pacific as far eastward as the Tuamotus. There are no records from Hawaii. Dana reported the species from Wake Island as *Aniculus typicus*.

Aniculus strigatus Herbst.

Aniculus strigatus Alcock, Cat. Indian Decapod Crust., pt. 2, fasc. 1, p. 97, pl. 7, fig. 4, 1905.

One specimen was collected at French Frigate Shoals. The species is distributed through the Indian Ocean and is known from the Loyalty Islands and Tahiti in the South Pacific, and ranges northward to Hawaii.

Dardanus punctulatus (Olivier).

Pagurus punctulatus Alcock, Cat. Indian Decapod Crust., pt. 2, fasc. 1, p. 81, pl. 8, fig. 1, 1905.

Two specimens were collected at Johnston Island. The species ranges through the Indian Ocean and the Pacific as far northward as Hawaii.

Dardanus asper (de Haan).

Pagurus asper Alcock, Cat. Indian Decapod Crust., pt. 2, fasc. 1, p. 90, pl. 9, fig. 5, 1905.

Nine specimens were taken by the Tanager Expedition, two of which were collected at French Frigate Shoals, one at Wake Island and six at Laysan Island. The species ranges from the eastern section of the Indian Ocean to Japan, Australia, and Hawaii.

Dardanus deformis (Milne Edwards).

Pagurus deformis Alcock, Cat. Indian Decapod Crust., pt. 2, fasc. 1, p. 88, pl. 9, fig. 4, 1905.

One specimen was collected at Wake Island. The species is distributed through the Indian and Pacific oceans to Tahiti and northward to Hawaii. Numerous specimens have been taken on the reefs of Oahu.

Dardanus sanguinocarpus, new species (9). (Pl. II, *A*; fig. 5, *a, b*.)

Type specimen, total length 32 mm.; length of carapace 19 mm.; type locality, Oahu, on the reef. Bishop Museum collections No. 1813.

Carapace somewhat convex longitudinally and transversely, with tufts of yellowish bristles on and near the anterior and antero-lateral borders, as well as scattered scantily over the dorsal surface. Width of the crustate part about four-sevenths the length of the entire carapace in the middle line (Pl. II, *A*).

Eyestalks slightly depressed and inflated distally; a little shorter than the anterior border of the carapace, but exceeding the antennular peduncle in length

by 2 mm. and the antennal peduncle by 3 mm. Ophthalmic scales notched on the anterior border, spinulose and setose. Antennal acicle just overlapping the base

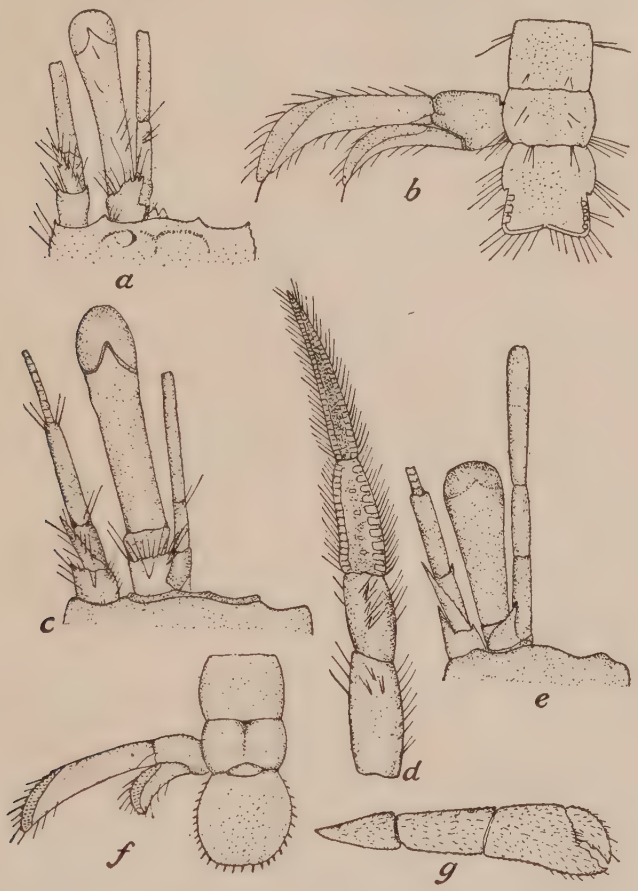

FIGURE 5. *Dardanus sanguinocarpus* (*a-b*), *Dardanus sulcatus* (*c-d*), and *Sympagurus pacificus* (*e-g*), new species: *a*, anterior border of carapace, eye-stalk and peduncles of antenna and antennule; *b*, terminal segments of abdomen with left uropod (right uropod which is smaller than left is not shown); *c*, anterior border of carapace, eye-stalk and peduncles of antenna and antennule; *d*, third leg on left side; *e*, anterior border of carapace, eye-stalk and peduncles of antenna and antennule; *f*, terminal segments of abdomen with left uropod (right upropod which is smaller than left is not shown, telson is slightly asymmetrical in type specimen); *g*, right cheliped.

of the terminal segment of the antennal peduncle, spinose and strongly setose (fig. 5, *a*).

Left cheliped longer and much stouter than right. Merus a little longer than wide on outer face, as wide as long on inner surface. Lower outer and inner margins spinose, the inner more strongly so; narrow upper border and outer surface roughened by squamiform folds the anterior border of each being spinulose and setose. Upper distal margin of the outer surface of merus strongly toothed. Carpus

short and stout; upper and outer surfaces armed with spines, those toward the upper border very strong with black tips, curving forward. A few yellowish bristles arise from the base of the spines.

Palm of chela wider than long, upper border and outer surface armed with erect, black tipped spines that tend to be arranged in longitudinal rows. Long reddish bristles, some with white tips, arise from the base of the spines. Lower border of palm and basal portion of immovable finger flaring outward in a very conspicuous manner. Fingers spinose and setose; cutting edges with a few bluntly rounded teeth. Inner surface of cheliped smoother than outer; tufts of bristles few on merus and carpus, becoming more numerous on palm and fingers. Lower inner surface of palm spinulose.

Right cheliped less strongly armed than the left. Upper border of palm strongly spinose, lower two-thirds of outer surface almost free from spines. Long bristles, similar to those of the left cheliped, increase in density from the merus to the fingers.

Second pair of legs shorter than the third. The second and third legs of the right side differ little from one another. Lower border of merus with a few spinules; upper border of carpus near the distal extremity armed with two strong spines; upper border of propodus and dactylus spinulose and densely covered with tufts of long bristles. The posterior face of merus, carpus and propodus is quite free from spines; especially is the upper posterior surface of the carpus smooth and polished. Bristles similar to those of the chelipeds fringe the borders of the segments and become more numerous on the propodus and dactylus.

The third leg on the left side differs from the second with respect to the propodus and dactylus. In the third leg these two segments are nearly twice as wide as those of the second leg, and both segments are deeply grooved longitudinally on the posterior surface. Sharp spines border this groove on either side. Otherwise the legs of the left side are armed with spines and bristles similar to those of the right side.

The general ground color of the type specimen is a warm gray with numerous whitish spots that tend to run together on the anterior part of the carapace. On the anterior, mid-dorsal surface of the carapace is an area purplish-slate in color, appearing almost black. This area is somewhat deltoid in shape extending laterally a little beyond the bases of the eyestalks. On either side of this dark area and a little posteriorly is a bright red area. Behind these areas the carapace becomes purple merging posteriorly into the ground color of the animal. The softer parts of the carapace and the abdomen are marked by broken, irregular lines of dark red. Eyestalks purplish-yellow, almost clear yellow just behind the cornea. Antenna and antennules yellow. Upper half of carpus of chelipeds marked by a bright red area unevenly surrounded by purple. The spines of both the purple and red areas are purple in color. To a lesser extent the merus of each cheliped is marked in a manner similar to that of the carpus. The polished area of the posterior surface of the carpus of the second and third legs is purplish-slate in color like that of the deltoid area of the carapace.

The species bears some relationship to *D. setifer* (Milne Edwards) (1, p. 83, fig. 3), in that the eyestalks are longer than the antennular peduncles, but differs from it in the characters of the chelipeds and the third left leg. It seems to differ from *D. sanguinolentus* (Quoy and Gaimard) (14, p. 532, pl. 79, fig. 2) in the proportionate length and character of the chelipeds, in the form of the third leg on the left side and in coloration.

The type specimen, inhabiting a shell of *Turbo intercostalis* Menke, was taken in shallow water near Diamond Head, Oahu, in April, 1923. A second specimen, also an ovigerous female, was collected in the same locality the following month. It is deposited in the United States National Museum. Another specimen is recorded from Waikiki reef, Honolulu, and several immature specimens were collected

near Haleiwa, Oahu, inhabiting shells of a common species of Cypraea. One specimen was collected during the Tanager Expedition at French Frigate Shoals.

Dardanus sulcatus, new species. (Pl. II, *B*; fig. 5, *c*, *d*.)

Holotype an ovigerous female; length of carapace 12 mm., greatest breadth across branchial region 10 mm. Type locality French Frigate Shoals. Bishop Museum collections No. 1815.

This species is apparently closely related to *D. setifer* (Milne Edwards) (1, p. 83, pl. 8, fig. 3), but differs from it primarily in the character of the surface of the chelipeds and in the proportionate size of the segments of the third leg of the left side.

Carapace depressed, almost flat, with tufts of yellow bristles on the antero-lateral borders, the front margin and the dorsal surface (Pl. II, *B*). Eyestalks longer than the width of the anterior border of the carapace, a little depressed distally with the ocular portion but slightly expanded. They exceed the antennular peduncles in length by 2 mm. and the antennal peduncles by nearly 3 mm. Front border of ophthalmic scales nearly straight with a few minute spines and strongly setose. Acicle of antennal peduncle short, spine-like, reaching but slightly beyond the base of the terminal segment and densely covered with long bristles (fig. 5, *c*); flagellum of antenna longer than carapace.

Chelipeds similar in form, the left slightly longer and larger than the right. Merus of left cheliped twice as long as broad, lower border with a few small spines increasing in size toward the distal extremity; outer surface roughened by more or less conspicuous wrinkles, vertically arranged, and thickly covered with long yellow and red bristles, the yellow ones more numerous. There are a few spinules on the anterior margin of the outer surface of the merus and also on the distal border of the more prominent wrinkles. Wrist as broad as long; outer surface and upper and lower borders covered with numerous bristles among which are a few short spines. Hand with palm as broad as long; entire outer surface, upper and lower borders, together with fingers, densely covered with tufts of long yellow and red bristles which more or less conceal short spines. A row of stronger spines marks the upper margin of the palm. Fingers slightly shorter than upper border of palm, cutting edges with low blunt teeth. Cheliped comparatively smooth on inner surface; segments with a few tufts of bristles becoming more numerous on the fingers. The right cheliped resembles the left in form and character of surface but differs from it in being somewhat smaller.

Second and third legs on the right side longer than those on the left side. All are covered with tufts of yellow and red bristles becoming more dense on the terminal segments. Numerous spinules are interspersed among the bristles. The outer surface of the propodus and dactylus of the third leg on the left side resembles *D. setifer* (Milne Edwards) in ornamentation but the segments are proportionately longer in my species, the propodus being a little more than twice as long as broad. In *D. setifer* the breadth of the propodus is three-fifths its length. In the third leg on the left side in my species a shallow longitudinal groove traverses the upper border of the carpus near its posterior margin, and the posterior surface of the propodus and dactylus is marked by a deep, broad furrow extending their entire length. Transverse grooves divide the furrowed surface of these segments into a series of scutes of almost uniform size, the distal border of each having a fringe of very short, fine setae. On the upper and lower borders of the propodus and dactylus is a dense fringe of long bristles in addition to those arranged in tufts on the general surface of the leg (fig. 5, *d*).

After having been in alcohol for more than a year the color of the carapace and abdomen is very pale yellow, almost white; eyestalks, antennae, antennules,

and legs are light yellowish-brown becoming slightly deeper in color toward the extremities of the appendages; bristles yellow and red; corneas of eyes, tips of chelae and claws black.

Sympagurus pacificus, new species. (Pl. II, *C*; fig. 5, *e-g*.)

Holotype having a total length of 13 mm.; length of carapace 5 mm.; width of front border of carapace 2 mm. Type locality, off Laysan Island at a depth of 200 fathoms. Bishop Museum collections No. 1816.

A form resembling Parapagurus in general appearance but by reason of the character of the gills is placed under the genus Sympagurus.

Carapace with parallel sides, strongly convex transversely, smooth, without spines or hairs (Pl. II, *C*). Eyestalks stout, somewhat expanded distally, slightly shorter than the width of the front border of the carapace. They slightly exceed the antennal peduncle in length and extend little beyond the base of the terminal segment of the antennular peduncle. Ophthalmic scales terminating antero-medially in a sharp spine. Antennal acicle spine-like, reaching distally of the middle of the eyestalks, with the medial border spinulose and supporting a few fine hairs (fig. 5, *e*).

Right cheliped (fig. 5, *f*) much longer and stouter than the left. Merus narrow proximally becoming broader distally, a little longer than greatest breadth; inner surface flattened, smooth; lateral surface convex, slightly roughened by smooth, rounded granules of microscopic size. The lower border is weakly serrate. Carpus longer and stouter than merus with the medial surface less flattened. Surface more conspicuously granulate than that of merus, some of the granules becoming sharp on the upper distal border. Hand, including fingers, as long as the carpus but stouter. Palm increasing in breadth distally, medial and lateral surfaces convex; upper border rounded, lower border, including immovable finger, sharp and serrated. Fingers stout, as long as upper border of palm, slightly curving medially. Surface of palm, together with fingers, covered with smooth, rounded granules of larger size than those of carpus. On the upper border of the palm the granules, or minute tubercles, are more densely crowded extending on the dorsal border of the movable finger as a granulate crest. Very short, yellowish hairs are interspersed among the granules on the segments of the cheliped.

Left cheliped slender, reaching slightly beyond the distal extremity of the carpus of the right cheliped, general surface smooth. Carpus longer and stouter than merus; upper and lower borders of both segments with a fringe of long fine hairs, more numerous and longer on the upper border. Upper and lateral distal borders of carpus each with a sharp spine. Hand, including fingers, equal in length to carpus palm slightly longer than broad and about equal in length to the slender fingers. Tufts of long fine hairs border the palm and cover the fingers.

Second and third legs quite similar, all slightly reaching beyond the distal extremity of the right cheliped when drawn forward. Third leg on either side slightly longer than second; length of merus a little more than three times its greatest breadth, longer than the carpus and a little shorter than the propodus. Dactylus about equal to carpus and propodus together. Upper border of merus, carpus and propodus with a few short, movable spinules. A short immovable spine terminates the upper distal extremity of the carpus. In the third leg on either side, the merus and carpus are slightly broader and stouter than the corresponding segments of the second leg, and the dactylus is a little longer and more strongly curved.

The Tanager form differs from *S. arcuatus* (12, p. 67, pl. 5, figs. 21-28) and *S. bicristatus* (12, p. 154, pl. 11, figs. 11, 12), Atlantic species of Edwards and Bouvier, and the Indian Ocean varieties of these species as

var. *monstrosus* (1, p. 105, pl. 10, fig. 5) and var. *indicus* (1, p. 105, pl. 10, fig. 4) as defined by Alcock, in the absence of a crest on the upper border of the right palm and in other features of both chelipeds. It differs from *S. pictus* Smith (25) and *S. pilimanus* (A. M. Edwards) (12, p. 63, pl. 5, figs. 8-20) in the less strongly pubescent character of the chelipeds and in the armature of those appendages. From the Atlantic species and the Indian Ocean varieties it seems to differ also in the proportionate length of eyestalks and peduncles of antennules and antennae. In the Tanager species the eyestalks reach beyond the distal extremity of the second segment of the peduncle of the antennule and considerably beyond the peduncle of the antenna.

Pagurus zebra (Henderson).

Eupagurus zebra Henderson, Linn. Soc., Zoology Trans., vol. 5, p. 425, pl. 39, figs. 12-15, 1893: Alcock, Cat. Indian Decapod Crust., pt. 2, fasc. 1, Pagurides, p. 126, pl. 11, fig. 5, 1905.

Two specimens which were taken on the Tanager Expedition at French Frigate Shoals are consigned to this species. They agree with Henderson's description of the type specimen in the chief characteristics but differ from the established species in certain minor features perhaps of varietal value. In the specimens from French Frigate Shoals the antennular peduncle is comparatively shorter than indicated by Henderson's description and figures, being subequal in length to that of the antenna instead of considerably longer. In the Tanager specimens the left cheliped reaches beyond the base of the dactylus of the right cheliped instead of falling short of it as Alcock states regarding the specimens collected by the "Investigator."

After being in alcohol for more than a year the original color of the specimens from French Frigate Shoals has probably faded to some extent. A crimson color faintly indicated on the distal portion of the merus of the walking legs and the left cheliped grows deeper on the following segments and becomes fainter again at the tips of the appendages. Longitudinal stripes of a deeper red color are indicated on these same appendages. The eye-stalks and peduncles of antennae and antennules are faintly crimson toward their distal extremities, while the flagellum of the antenna is deep red in color especially toward the distal two-thirds of its length. The right cheliped is colorless.

Both specimens collected at French Frigate Shoals are females, one being ovigerous. They are approximately equal in size, about 12 mm. long, with the right cheliped 8 mm. long.

The species has been taken from off the northwest coast of Australia in 53 fathoms, which is the type locality; off the coast of Ceylon in 28 fathoms; from the Andamans, and from the Persian Gulf in 49 fathoms.

Tribe BRACHYURA

Subtribe DROMIACEA

Family DYNOMENIDAE

Dynomene hispida Desmarest.

Dynomene hispida Desmarest, Consid. sur les Crust., p. 133, pl. 18, fig. 2, 1825.

One specimen was collected at Ocean Island and four at Johnston Island. The range of this species includes Mauritius and other localities in the Indian Ocean, and the most leeward island of the Hawaiian chain. I have taken it on the reefs of Oahu.

Subtribe OXYSTOMATA

Family LEUCOSIIDAE

Nucia speciosa Dana.

Nucia speciosa Dana, U. S. Expl. Exped., vol. 13, Crust., p. 397, 1852; pl. 25, fig. 5, 1855.

One specimen was collected at Johnston Island. Previous records indicate the range of the species to be from Mauritius and the Red Sea through the Indian Archipelago, to New Caledonia and northward to Hawaii. The "Albatross" took the species near Laysan in 1902, and in recent years I have taken it on the reefs of Oahu.

Oreophorus (Oreotlos) latus (Borradaile).

Tlos latus Borradaile, Fauna and Geogr. Maldive and Laccadive Archipelagoes, vol. 1, pt. 4, p. 437, text fig. 115, 1903.

Oreophorus (Oreotlos) latus Ihle, Decapoda Brachyura der Siboga-Expedition, III, p. 217, 1918.

Two specimens were taken by the Tanager Expedition at Laysan Island. Borradaile described the species from the Male Atolls in the Indian Ocean.

Actaeomorpha erosa Miers.

Actaeomorpha erosa Miers, Linn. Soc. Journ., vol. 13, p. 183, pl. 14, figs. 1-6, 1878.

One young specimen which conforms closely to this species was collected at Ocean Island. The carapace of this specimen is not so deeply pitted as is that of an adult of this species which I took on the south shore of Molokai in 1921. The type locality of the species is Port Curtis, Australia.

Family CALAPPIDAE

Calappa hepatica (Linnaeus).

Calappa hepatica Alcock, Asiat. Soc. Bengal Journ., vol. 65, p. 142, 1896.

Seven specimens in all were collected at Ocean, Johnston, and Wake islands, besides a carapace at Laysan Island. The species is distributed

from the Red Sea through the Indian and Pacific oceans as far north as Hawaii, where it is very common about the larger islands of the group.

Calappa gallus (Herbst).

Calappa gallus Alcock, Asiat. Soc. Bengal Journ., vol. 65, p. 146, 1896.

One specimen was taken at French Frigate Shoals and one at Wake Island. The species apparently has a range from the Red Sea, through the Indian and Pacific oceans parallel with that of the preceding species but is much less common than *Calappa hepatica* in Hawaii. The species has been reported from West African localities by Rathbun and Bouvier, and is also known from the Florida Keys to the shores of Brazil.

Subtribe BRACHYGNATHA

Family INACHIDAE

Perinea tumida Dana.

Perinea tumida Dana, U. S. Expl. Exped. vol. 13, Crust., p. 114, 1852; pl. 4, fig. 1 a-f, 1855.

This species is well distributed throughout the area surveyed by the Tanager Expedition. Fifty-two specimens in all were taken at Pearl and Hermes Reef, French Frigate Shoals, Ocean, Laysan, Johnston, and Wake islands. Previous records of its distribution include the Red Sea, the Indian Ocean, Australia, Fiji and Hawaii. Dana's specimen was dredged at Lahaina, Maui. On the reefs of Oahu it is a common species.

Menaethius monoceros (Latreille).

Menaethius monoceros Alcock, Asiat. Soc. Bengal Journ., vol. 64, p. 197, 1895.

Seven specimens in all were collected at Pearl and Hermes Reef, Ocean, Lisiansky, and Laysan islands. The species ranges from the Red Sea through the Indian and Pacific oceans eastward to the Tuamotus and northward to Japan. Previous records include many localities in Hawaii where it is quite common.

Simocarcinus simplex (Dana).

Simocarcinus simplex Alcock, Asiat. Soc. Bengal Journ., vol. 64, p. 196, 1895.

Four specimens were taken at Laysan Island and six at Wake Island. There are previous records of the species from the Red Sea. Dana described it from Hawaii as *Huenia simplex*. It is very common on the reefs of Oahu where it lives among seaweed.

Schizophrys hilensis Rathbun.

Schizophrys hilensis Rathbun, U. S. Fish Comm. Bull., vol. 23, pt. 3, p. 882, text fig. 38, 1906.

Two specimens were taken at Pearl and Hermes Reef, one at Necker

Island and four at Laysan Island. The range of the species is apparently confined to the Hawaiian islands.

Family PARTHENOPIDAE

Daldorfia horrida (Linnaeus).

Parthenope horrida Alcock, Asiat. Soc. Bengal Journ., vol. 64, p. 279, 1895.
Daldorfia horrida Rathbun, U. S. Fish Comm. Bull., vol. 23, pt. 3, p. 886, pl. 14, fig. 5, text fig. 39, 1906.

One specimen was taken by the Tanager Expedition at each of the following localities: French Frigate Shoals, Laysan, and Ocean islands. There are a number of previous records of the species from Hawaii. Lenz reported it from Laysan in 1901, and I have taken several specimens from the reefs of Oahu in recent years. Alcock listed it from off Ceylon and A. M. Edwards recorded it from New Caledonia. Its range probably also includes the Indian Ocean.

Family HAPALOCARCINIDAE

Hapalocarcinus marsupialis Stimpson.

Hapalocarcinus marsupialis Stimpson, Boston Soc. Nat. Hist. Proc., vol. 6, p. 412, 1856-1858; Calman, Linn. Soc. Zool. Trans., vol. 8, p. 43, 1900; Potts, Carnegie Inst. of Washington, Dept. Marine Biology papers, vol. 8, p. 35, 1915.

Twenty-three specimens in all were collected at Laysan, Johnston, and Wake islands. In Hawaii the species is very common, usually forming galls on the coral, *Pocillopora cespitosa,* and occasionally on *P. meandrina* var. *nobilis*. At Johnston Island, however, where *P. cespitosa* is rare and very poorly developed the galls of the crab are almost always found on a coral of the *P. meandrina* form. At Laysan and Wake islands *P. cespitosa* grows abundantly and vigorously and the galls of the crab were not observed on any other species of coral. The range of this commensal crab includes the Indian and Pacific oceans conforming with the distribution of coral reefs bearing species of the genera Pocillopora, Seriatopora, Stylophora, Sideropora and Millepora.

Cryptochirus coralliodytes Heller. (Pl. 1, *D-F.*)

Cryptochirus coralliodytes Heller, Beitr. 2, Crustaceen-Fauna des rothen Meeres. S. B. Akad, Wien. vol. 43, (1), p. 370, pl. 4, figs. 33-35, 1861.

A form which I have placed under this species was taken at Wake Island, inhabiting pits in a coral head which appears to be *Favia matthaii* Vaughan. The crab conforms very closely with the original description of the species as given by Heller. A perfect specimen of an ovigerous female was secured having a carapace 5 mm. long and 3.5 mm. broad. The circular pit in the coral head occupied by this specimen measured 4 mm. in diameter and 20 mm. deep.

Cryptochirus crescentus, new species. (Fig. 6, *a-i*; Pl. 1, *B, C.*)

Type specimen an ovigerous female with carapace 2¼ mm. long by 2 mm. broad. Type locality, Johnston Island, occupying crescent-shaped burrows in *Pavona duerdeni* Vaughan, a coral not uncommon on the outer reef of that island. Type specimen in Bishop Museum collections No. 1805.

This new Cryptochirus is characterized by having a broad, depressed carapace (fig. 6, *a* and Pl. 1, *B*), the posterior three-fourths of which is flattened in a longitudinal direction, and but slightly convex transversely.

In the type specimen the anterior one-fourth of the carapace is bent down at an angle of 45 degrees (fig. 6, *b*). In the male specimen there is but a slight deflection of this portion of the carapace. In the largest female measured the carapace was 3 mm. long by 2½ mm. broad. The carapace of the largest male observed measured 2½ mm. in length by 2 mm. broad.

Type specimen with front border of carapace concave between the inner supraorbital angles, margin of border roughened by small tubercles. Orbits, as viewed from above, deep V-shaped incisions, borders tuberculate, both inner and outer supraorbital angles bluntly pointed, covered with short, sharp tubercles, one of which on the inner supraorbital angle is spine-like. The deflected anterior portion of the carapace is marked by a deep, broad depression transversely across the pre-gastric region, the arms of which curve backward toward the posterior extremity of each antero-lateral border.

Upper surface of carapace entirely covered with tubercles, which on the posterior region are small and low, becoming larger and more spine-like anteriorly. Antero-lateral borders of carapace with a row of spines of about the same size as those of the upper surface of the carapace in this region and with which they merge posteriorly. The lateral surfaces of the anterior portion of the carapace, which are nearly at right angles with the dorsal surface, are covered with small, rounded tubercles.

Eyestalks short, thick, medial surface with numerous sharp spines. Basal segment of antennule bordered anteriorly by spines and with dorsal and ventral surfaces granulate and tuberculate (fig. 6, *d*). The first four segments of the antenna (fig. 6, *c*) are shorter than the basal segment of the antennule.

Ischium of outer maxillipeds nearly as broad as long, with the merus deeply set in its outer distal border. Exposed surface of ischium granular and tuberculate; exopodite about one-half as long as outer border of ischium (fig. 6, *e*).

Chelipeds of type specimen similar in size (fig. 6, *f*). Merus not quite twice as long as broad, inner surface concave, outer surface convex, smooth; distal three-fourths of lower border flattened, slight serrations and small tubercles along upper border. Wrist with sharp tubercles on upper border, terminating in spines anteriorly. Palm of hand compressed laterally, approximately as broad as long, the rounded upper border being covered with tubercles which extend down over the upper portion of the inner surface of the palm. Fingers deflected, as long as palm, sharp pointed, tips crossing when closed, cutting edges smooth. A few hairs and short bristles fringe the upper and lower borders of each segment of the cheliped. Entire length of cheliped in type specimen 2 mm.

The second leg in the type specimen (fig. 6, *g*) is much stouter than the cheliped; coxopodite with a strong spine on the upper border; merus as broad as long, both lateral and medial surfaces concave, medial surface strongly so. Distally the merus is expanded into a lobe-like extension, directed medially. Into the deep concavity of

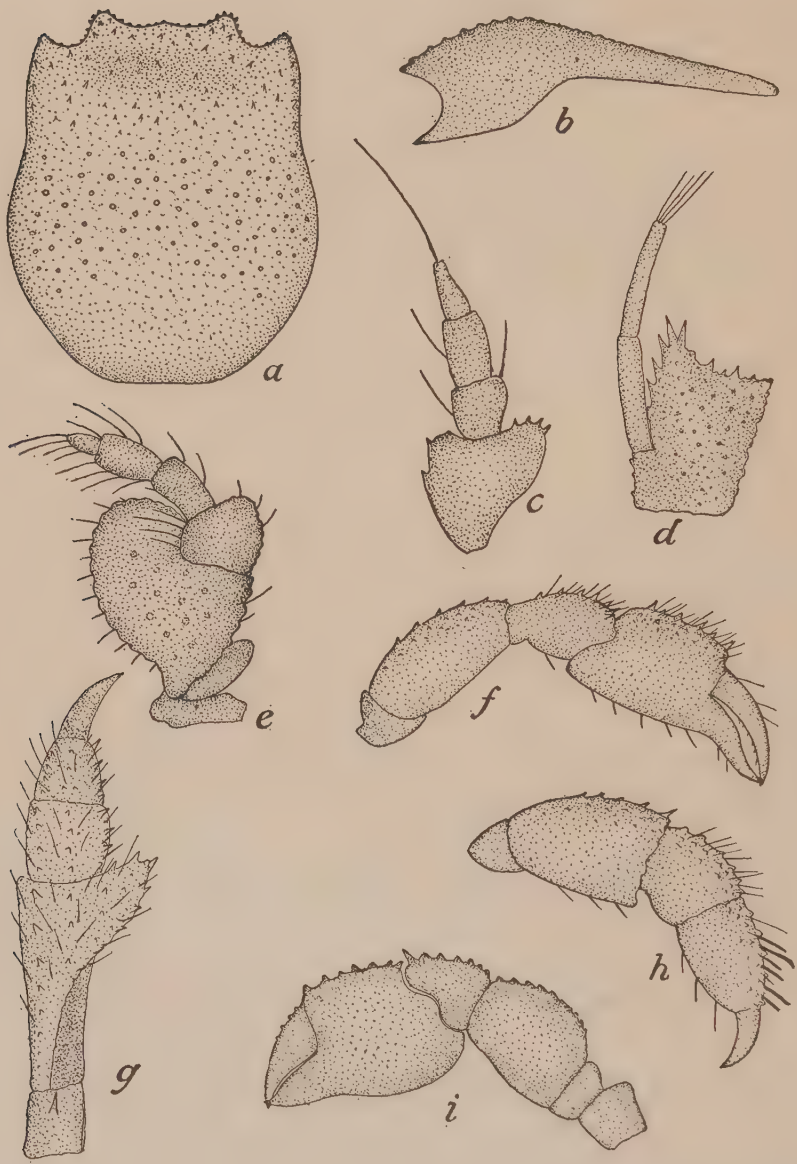

FIGURE 6. *Cryptochirus crescentus*, new species: *a*, dorsal surface of carapace; *b*, lateral view of carapace; *c*, right antenna from ventral surface; *d*, left antennule from ventral surface; *e*, outer maxilliped, left side; *f*, right cheliped (♀); *g*, second leg (♀), left side; *h*, fourth walking leg (♀), right side; *i*, left cheliped (♂).

the medial surface of the merus fits the cheliped while the third leg rests in the concavity of the lateral surface. Lower border of merus rounded and roughened by small tubercles; upper border narrow proximally, broadly rounded or almost flattened distally, covered by rounded tubercles many of which are spine-like. Carpus and propodus each short, stout, covered with sharp tubercles. The stout dactylus is slightly roughened by tubercles at the base. Long hairs are interspersed with the tubercles on the upper border of the segments.

The fifth leg is smaller than the fourth and the fourth smaller than the third; merus in third and fourth leg as broad as long, and a little longer in proportion to breadth in the fifth. A blunt, tooth-like process terminates the distal extremity of the lower border of the merus in each of the three legs. Carpus and propodus in these three legs short and stout, surface of segments more or less roughened by tubercles, some of which become sharp especially along the upper borders (fig. 6, *h*). Fifth leg smoother than fourth, and fourth smoother than third. Hairs and bristles fringe the borders of the segments of the legs.

In this species the male differs from the female in size and in the more flattened character of the carapace, as previously mentioned. A sexual difference is also noted in the appendages. The chelipeds of the male (fig. 6, *i*) are longer than those of the female, the hands being more massive and the fingers shorter. In the male the merus of the second leg is less widely expanded at the distal extremity than in the female. The abdomen of the male consists of seven distinct segments with the sides gradually converging to the rounded distal extremity.

Most of the crescent-shaped pits in *Pavona duerdeni* inhabited by this species (Pl. I, *C*) are from 11 to 12 mm. deep, although one measured was 18 mm. deep. The convexity of the opening of the pit is dorsal in relation to the crab, the flattened or concave side of the crescent being ventral. At the tips of the crescent are observed small rounded pockets which extend to a lower level than the ventral floor of the opening. In these pockets the distally expanded extremity of the second leg of the crab rests. Males and females have been found in separate pits in the same coral colony.

That this species also ranges into the Hawaiian islands is shown by the presence of similar pits in specimens of *Pavona duerdeni* taken at Pukoo, Molokai, and now in the Bishop Museum. All of the pits in these preserved and bleached specimens of coral are, however, free from crabs. The same species of coral collected on Waikiki reef, Honolulu, in 1924 showed no evidence of the presence of the crab.

Verrill (28) described a coral crab, inhabiting semicircular or lunate pits in several species of corals of Bermuda, under the name *Troglacarcinus coralliocola,* the generic term employed also being new. Verrill's form which is probably a Cryptochirus seems to differ from the Johnston Island species in the character of the spines of the antero-lateral border, in the outer maxillipeds, and perhaps in the chelipeds and first pair of walking legs.

The Johnston Island species may readily be distinguished from either *Cryptochirus coralliodytes* Heller or *Cryptochirus dimorphus* Henderson (18), which are Indo-Pacific in distribution, by the form of the carapace, the chelipeds and first pair of walking legs, as well as by the shape of the cavity in the coral which it inhabits.

Family CANCRIDAE

Kraussia rugulosa (Krauss).

Kraussia rugulosa Dana, U. S. Expl. Exped. vol. 13, Crust., p. 302, 1852; pl. 19, fig. a-f, 1855.

Three specimens which agree with Dana's description were taken at Wake Island. Dana reported the species from the island of Maui. Krauss recorded it from South Africa. Although it seems to have an extensive range it has been taken in few localities.

Family PORTUNIDAE

Lissocarcinus orbicularis Dana.

Lissocarcinus orbicularis Alcock, Asiat. Soc. Bengal Journ., vol. 68, p. 20, 1899.

One specimen was collected at Wake Island. Previous records are from the Red Sea, the Indian Ocean, Ceylon, Torres Straits, and through the Pacific to Hawaii. On the reefs of Oahu it is a very common species, living as a commensal in the oral regions of the holothurian, *Holothuria fusco-rubra* Théel.

Carupa laeviuscula Heller.

Carupa laeviuscula Alcock, Asiat. Soc. Bengal Journ., vol. 68, p. 26, 1899.

Five specimens in all were collected at Pearl and Hermes Reef, Lisiansky, and Wake islands. Previous records indicate a wide range of the species, including the Red Sea, the Indian Ocean and eastward in the Pacific to the Tuamotus and northward to Hawaii. Lenz reported it from Laysan Island in 1901. The Bishop Museum collections include numerous specimens from Oahu.

Goniocaphyra inaequalis Rathbun.

Goniocaphyra inaequalis Rathbun, U. S. Fish Comm. Bull., vol. 23, pt. 3, p. 870, pl. 12, fig. 9, text fig. 29, 1906.

Thirteen specimens were collected at Johnston Island from dead coral heads in shallow water. Previous records of the species are from Hawaii, where it was taken by the "Albatross" at depths ranging from 13 to 179 fathoms. I have taken a number of specimens on Waikiki reef, Oahu, in shallow water.

Portunus (Xiphonectes) longispinosus (Dana).

Portunus (*Xiphonectes*) *longispinosus* Rathbun, Mus. Comp. Zool. Bull., vol. 39, p. 130, 1902.

One specimen was taken by the Tanager Expedition at Laysan Island and one at Johnston Island. The range of the species is from the Red Sea through the Indian and Pacific oceans to Hawaii. Dana's record was from Fiji.

Portunus (Achelous) granulatus (Milne Edwards).

Neptunus (Achelous) granulatus Alcock, Asiat. Soc. Bengal Journ., vol. 68, p. 45, 1899.

Six specimens were taken in the lagoon at Wake Island. The species ranges from Mauritius and the Red Sea through the Indian and Pacific oceans eastward to the Tuamotus and northward to China, Japan, and Hawaii. Lenz reported it from Laysan Island in 1901. The Wake Island specimens were of such color as to blend perfectly with the white coral sand on which they rested and in which they burrowed.

Portunus pubescens (Dana).

Lupa pubescens Dana, U. S. Expl. Exped., vol. 13, Crust., p. 274, 1852; pl. 16, fig. 9, 1855.

Two specimens and a carapace were collected at Laysan Island, and one specimen at Lisiansky Island. Dana's record of the species was from Maui, and it is not uncommon in the shallow waters about Oahu.

Charybdis erythrodactyla (Lamarck).

Thalamita pulchra Randall, Acad. Nat. Sci. Phila. Journ., vol. 8, p. 117, pl. 4, 1839 (1840).

One specimen was collected by the Tanager Expedition at Wake Island. The species apparently ranges from the Red Sea through the Indian and Pacific oceans to Hawaii where it has frequently been taken. It is occasionally seen in the Honolulu fish market.

Thalamita admete (Herbst).

Cancer admete Herbst, Natur. d. Krabben u. Krebse, III, pt. 3, p. 40, pl. 57, fig. 1, 1803.

Thalamita admete Rathbun, U. S. Fish Comm. Bull., vol. 23, pt. 3, p. 874, 1906.

Nine specimens which correspond closely with Rathbun's application of the species were taken at Wake Island. Rathbun records the species, which is probably a variable one, from the China Sea, Samoa, Lord Howe Island, and Hawaii. The *T. admete* of Alcock, Borradaile and other authors has a much wider range, including the Red Sea and various localities in the Indian and Pacific oceans.

Thalamita edwardsi Borradaile.

Thalamita edwardsi Borradaile, Zool. Soc., London Proc., 1900, p. 579; Fauna and Geogr. Maldive and Laccadive Archipelagoes, vol. 1, p. 202, 1902: Rathbun, U. S. Fish Comm. Bull., vol. 23, pt. 3, p. 873, 1906.

Forty-five specimens in all were collected at Pearl and Hermes Reef, Ocean, Lisiansky, Laysan, and Johnston islands. Previous records of the species are from the Indian Ocean, Funafuti, Palmyra Island, and Hawaii. It is the most common species of the genus in Hawaii and also at Johnston Island.

Thalamita picta Stimpson.

Thalamita picta Stimpson, Acad. Nat. Sci. Phila. Proc., vol. 10, p. 39, 1858.

Four specimens in all were taken at Pearl and Hermes Reef, Necker and Wake islands. The species has a wide range from the Red Sea through the Indian and Pacific oceans. It has previously been reported from New Caledonia, Rotuma and Hawaii in the Pacific.

Thalamita wakensis, new species. (Fig. 7, *a-e*; Pl. III, *A*.)

Holotype, a male; greatest width of carapace 8 mm., length of carapace 5 mm. Type locality, Wake Island, shallow water on the reef. Bishop Museum collections No. 1807.

This apparently new Thalamita has the basal segment of the antenna shorter than the major diameter of the orbit and the front is cut into six lobes, exclusive of the inner supraorbital angles. The middle lobes of the front are on a lower level than the submedian ones and are partially overlapped by the latter. With respect to the frontal border the species resembles *T. imparimanus* Alcock (3, p. 87), but differs from that species in the character of the antero-lateral margin of the carapace, in the chelipeds and in the propodite of the last leg.

Carapace slightly convex, covered with short pile which does not conceal the transverse ridges which are disposed as in *T. crenata* (Latreille) with, however, an additional one across the cardiac region (Pl. III, *A*; fig. 7, *a*). The immediate post-frontal region of the carapace is covered with rounded granules. Supraorbital border finely crenulate, with two shallow grooves, the medial one the more prominent.

Antero-lateral borders cut into four acute teeth, of which the first, or outer orbital angle, is larger than the second, and the second is larger than the third, while the fourth is slightly longer and straighter than the second. This fourth tooth represents the fifth of those usually present, the fourth of those usually present being wholly absent. In the number and relative size of the teeth of the antero-lateral border, this species is in close agreement with *T. hanseni* Alcock (3, p. 88) and *T. pilumnoides* Borradaile (4, p. 207). The posterior border of the carapace is approximately one-third its greatest width.

The crenulated lower border of the orbit has a deep notch toward the lateral side and the inner angle is an obtuse tooth. Basal segment of antenna approximately one-half the length of the greatest diameter of the orbit, with three prominent tubercles on the basal half of its exposed surface and a crest of smaller tubercles with their bases fused on the distal half. The free extremity of the basal segment is evenly rounded.

Left cheliped in the type specimen (fig. 7, *c*) slightly larger than the right. Anterior border of arm with a row of five spines increasing in size distally; other surfaces of arm quite smooth, with a few scattered hairs. Upper and outer surfaces of wrist weakly costate, granular, with three short teeth; inner angle with a strong, sharp tooth. Hairs are interspersed with the granules on the wrist. Palm of hand with five distinct costae on upper and outer surfaces; upper costa with two spines, the proximal one the stronger; second costa granular proximally, with two spines, the distal one the smaller. A prominent spine appears near the articulation with the wrist. Third, fourth and fifth costae granular, the fourth extending, with a break and at a lower level, forward on the lateral surface of the immovable finger; the fifth extending without interruption the length of the immovable finger on its lower lateral surface. Lower surface of palm rounded, inner surface inflated, both finely but sparsely granulate.

Fingers slender, strongly hooked, longitudinally channelled, the movable one

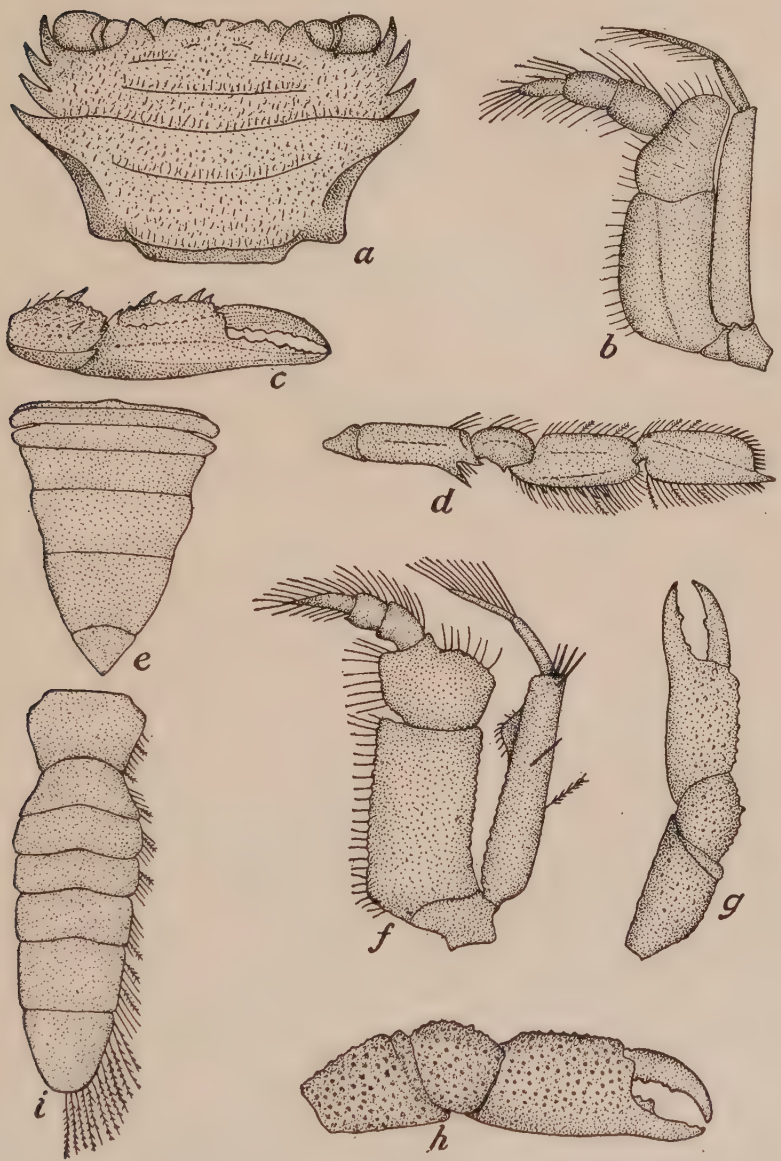

FIGURE 7. *Thalamita wakensis* (*a-e*) and *Chlorodiella asper* (*f-i*), new species: *a*, carapace, dorsal surface; *b*, outer maxilliped, left side; *c*, wrist and chela, right side; *d*, fifth leg, right side; *e*, telson; *f*, outer maxilliped, left side; *g*, left cheliped; *h*, right cheliped; *i*, abdomen.

slightly exceeding in length the upper border of the palm. Total length of left cheliped, 10 mm.

Second, third and fourth legs similar except in size. Third exceeding second in length by one-fourth the length of the dactylus; fourth but slightly exceeding third in length. Merus sharp above, carpus, propodus and dactylus grooved longitudinally on both anterior and posterior surfaces, a dense row of long hairs occupying the groove near the upper border of the anterior surface of these segments. In the second leg two additional parallel rows of hairs extend longitudinally on the anterior border of carpus and propodus. Dactylus slender, curved, in fourth leg equalling propodus in length. Fifth leg reaching almost to distal extremity of propodus of fourth leg.

Merus of fifth leg (fig. 7, *d*) slightly more than twice as long as broad, terminating on lower distal border in a sharp tooth, with another one subterminally placed. Lower border of propodus armed with seven spinules increasing in length toward the distal extremity. Upper and lower borders of segments of fifth leg fringed with hairs, which become feathered on the propodus and dactylus and spine-like toward the distal extremity of the terminal segment.

Terminal segment of abdomen of type specimen triangular, slightly broader than long. Total length of abdomen 4.5 mm. (fig. 7, *e*).

Thalamitoides quadridens A. M. Edwards.

Thalamitoides quadridens A. M. Edwards, Mus. Hist. Nat. Nouv. Arch., vol. 5, p. 147, pl. 6, figs. 8-15, 1869.

One specimen was taken at Johnston Island. Previous records of the species include Madagascar, Jaluit, and Samoa. There is a specimen of a closely related species, *T. tridens* A. M. Edwards, in the Bishop Museum from Guam.

Family PILUMNIDAE

Lybia tesselata (Latreille).

Melia tessellata Borradaile, Fauna and Geogr. Maldive and Laccadive Archipelagoes, vol. 1, p. 250, fig. 49, 1903.

Fifteen specimens in all were collected at Pearl and Hermes Reef, French Frigate Shoals, Ocean and Wake islands. The species has a wide range through the Indian and Pacific oceans northward to Hawaii where it has often been taken. Dana collected it at Wake Island in 1841. The species usually carries a small sea anemone in each chela.

Domecia hispida Eydoux and Souleyet.

Domecia hispida Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 230, 1898.

Ninety-eight specimens in all were collected at Pearl and Hermes Reef, French Frigate Shoals, Ocean, Lisiansky, Laysan, Johnston, and Wake islands. The species has an extensive range through the Indian and Pacific oceans, and may generally be found where reef-forming coral exists. It has also been recorded from the West Indies.

Tetralia glaberrima (Herbst).

Tetralia glaberrima Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 223, 1898.

Four specimens were taken at Johnston Island and 16 at Wake Island.

Previous records of the species include the Red Sea, various localities in the Indian Ocean and the Pacific as far as the Tuamotus. It is common at Palmyra Island but its distribution does not include Hawaii. It is associated with living coral.

Trapezia digitalis (Latreille).

Trapezia digitalis Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 222, 1898.

Forty-two specimens were collected at Laysan, Johnston, and Wake islands, the species being very common at Wake. Its distribution includes the Red Sea, the Indian and Pacific oceans to Hawaii, anl also the Pacific shores of Mexico. Like other species of the genus it is associated with living coral.

Trapezia digitalis speciosa (Dana).

Trapezia speciosa Dana, U. S. Expl. Exped., vol. 13, Crust., p. 253, 1852; pl. 15, fig. 1, 1855.

Four specimens were collected at Johnston Island and eight at Wake Island. The range of the species is from Mauritius through the Indian and Pacific oceans to the Tuamotus. Dana's specimens were taken from the Tuamotus.

Trapezia cymodoce intermedia Miers.

Trapezia ferruginea var. *intermedia* Miers, Voyage of the "Challenger," vol. 17, Brachyura, p. 168, pl. 12, fig. 2, 1886.

Ninety-four specimens in all were taken at Pearl and Hermes Reef, French Frigate Shoals, Ocean, Laysan, and Johnston islands. The range of the species is from the Indian Ocean to Hawaii.

Trapezia cymodoce ferruginea (Latreille).

Trapezia ferruginea Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 220, 1898.

Two specimens were taken at Johnston Island and 28 at Wake Island. The known range of the species is from the Red Sea, through the Indian and Pacific oceans to the shores of Mexico and Easter Island. It is very common at Palmyra Island and has frequently been taken in Hawaii although it is not represented in the Tanager collections from the leeward islands of Hawaii.

Trapezia rufopunctata (Herbst).

Trapezia rufopunctata Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 222, 1898.

Seventy-four specimens in all were taken at Pearl and Hermes Reef, Ocean, Lisiansky, Laysan, Johnston, and Wake islands. The species is known to range through the Indian and Pacific oceans to the Tuamotus and Hawaii.

Actumnus obesus Dana.

Actumnus obesus Dana, U. S. Expl. Exped., vol. 13, Crust., p. 244, 1852; pl. 14, fig. 3, 1855.

One specimen was taken at French Frigate Shoals and two at Wake Island, all in shallow water. The species has been reported from the Red Sea and the Indian Ocean. Dana's specimen was dredged near Lahaina, Maui. The "Albatross" took it off Molokai down to 73 fathoms. It has also been dredged off Waikiki reef, Honolulu, at from 30-50 fathoms, and has been collected in shallow water at other localities about Oahu.

Pilumnus cursor A. M. Edwards.

Pilumnus cursor A. M. Edwards, Mus. Hist. Nat. Nouv. Arch., vol. 9, p. 244, pl. 9, fig. 4, 1873; Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 195, 1898.

Eight specimens, taken at Wake Island, correspond closely with the descriptions of the species as given by Edwards and Alcock. The previously known distribution of *P. cursor* includes Australia, New Caledonia, Funafuti, and Samoa.

Dacryopilumnus eremita Nobili.

Dacryopilumnus eremita Nobili, Mus. Nat. Hist. Bull., Paris, 1906, p. 264; R. Accad. Sci. Torino Mem. 2, vol. 57, p. 400, pl. 2, figs. 4-4b, 1907.

One specimen was collected at Wake Island. Previous records of the species are from Rikitea, Makatea, Hao, and Amanu in the Tuamotu Islands. Nobili says the specimens from the Tuamotus were found in holes in dead madrepores.

Eriphia scabricula Dana.

Eriphia scabricula Dana, U. S. Expl. Exped., vol. 13, Crust., p. 247, 1852; pl. 14, figs. 5a and 5b, 1855.

One specimen was taken at Wake Island. The range of the species is from the Red Sea, through the Indian and Pacific Oceans to Australia and the Tuamotus. It is very common at Fanning Island and less so at Palmyra Island.

Lydia annulipes (Milne Edwards).

Ozius (Eurupellia) *annulipes* Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 188, 1898.

Twenty-three specimens were collected at Wake Island. Previous records include Muscat, the Liu Kiu Islands, Guam, Rotuma, Samoa, Marcus Island, Fanning and Palmyra islands and Hawaii.

Pseudozius caystrus (Adams and White).

Pseudozius caystrus Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 181, 1898.

Fifty-one specimens were collected at Wake Island. The species is distributed from the Red Sea through the Indian and Pacific oceans to the

Tuamotus and Hawaii, and is also known from Guam. It is very common at Palmyra and Fanning islands.

Pilodius flavus Rathbun.

Pilodius flavus Rathbun, U. S. Nat. Mus. Proc., vol. 16, p. 239, 1893; U. S. Fish Comm. Bull., vol. 23, pt. 3, p. 860, text-fig. 21, 1906.

Two specimens were taken at Pearl and Hermes Reef and two at Ocean Island, all in shallow water on the reefs. Rathbun reports the species from a number of localities among the leeward islands of the Hawaiian group at depths ranging from 14 to 160 fathoms. It has been taken off Waikiki reef, Oahu, in 30 to 50 fathoms, and also on the same reef in shallow water.

Cymo andreossyi (Audouin).

Cymo andreossyi Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 173, 1898.

Three specimens were collected at Wake Island. The species ranges from the Red Sea through the Indian Ocean and is known in the Pacific from Japan to Tahiti. It is a common form at Palmyra Island but has not been recorded from Hawaii and was not observed at Johnston Island during the Tanager Expedition.

Cymo melanodactylus de Haan.

Cymo melanodactylus Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 174, 1898.

Forty-eight specimens were collected at Wake Island. The species is known to range from the Red Sea through the Indian Ocean, and is known in the Pacific from China and Japan to Australia and the Tuamotus. It reaches Fanning and Palmyra islands but has not been recorded from Hawaii and was not taken at Johnston Island by the "Tanager." At Wake Island it is a very common species associated with coral colonies in the south channel leading from the lagoon to the sea.

Chlorodopsis scabricula (Dana).

Pilodius scabriculus Dana, U. S. Expl. Exped., vol. 13, Crust., p. 220, 1852; pl. 12, fig. 9, 1855.

Fifty-five specimens were collected at Wake Island where it is a very common species. It has been previously reported from the Indian Ocean, Balibac Passage, Tahiti, the Tuamotus, Fanning and Palmyra islands, and Hawaii. The species apparently does not range through the leeward islands of the Hawaiian group and was not seen at Johnston Island during the survey of the "Tanager." It is not common in Hawaii.

Chlorodopsis aberrans Rathbun.

Chlorodopsis aberrans Rathbun, U. S. Fish Comm. Bull., vol. 23, pt. 3, p. 859, text fig. 20, 1906.

Fifteen specimens were collected at Johnston Island. The type specimen,

described by Rathbun, was taken near Nihoa by the "Albatross" at depths from 23 to 26 fathoms. I know of no other record of the species.

Phymodius nitidus (Dana).

Pilodius nitidus Dana, U. S. Expl. Exped., vol. 13, Crust., p. 218, 1852; pl. 12, fig. 7, 1855.

In all, 185 specimens were taken at Pearl and Hermes Reef, French Frigate Shoals, Lisiansky, Laysan, Necker, Johnston, and Wake islands. It is especially well represented in collections from French Frigate Shoals, Lisiansky, Laysan, and Johnston islands. Previous records include localities in the Indian Ocean, Samoa, Fanning, and Palmyra islands, and Hawaii. It is very common on the reefs of Oahu.

Phymodius laysani Rathbun.

Phymodius laysani Rathbun, U. S. Fish Comm. Bull., vol. 23, pt. 3, pl. 12, fig. 8, text fig. 19, 1906.

One hundred and twenty-one specimens in all were taken at Pearl and Hermes Reef, French Frigate Shoals, Ocean, Laysan, and Johnston islands. It was well represented in collections from Ocean and Laysan islands and was very abundant at Johnston, where 81 of the specimens were collected. Rathbun described the species from a specimen taken at Laysan Island in 1902. A number of specimens collected on Waikiki reef, Oahu, are in the Bishop Museum.

Phymodius ungulatus (Milne Edwards).

Phymodius ungulatus Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 162, 1898.

Ninety-four specimens in all were taken, of which 85 are in collections from Wake Island, the others being from Pearl and Hermes Reef, Lisiansky, and Laysan islands. The species ranges from Mauritius and the Red Sea throughout the Indian Ocean and in the Pacific to the Tuamotus and Hawaii.

Chlorodiella niger (Forskål).

Chlorodiella niger Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 160, 1898.

In all, 775 specimens were taken, the species being well represented in collections from all of the low islands covered by the Tanager Expedition. This common species is widely distributed from the Red Sea through the Indian and Pacific oceans to the Tuamotus and northward to Hawaii.

Chlorodiella asper, new species. (Fig. 7, *f-i*; Pl. III, *C*.)

Type specimen an ovigerous female; greatest width of carapace 4 mm., length of carapace 3 mm. Type locality, Johnston Island. Bishop Museum collections No. 1810.

Carapace ovoid, dorsal surface slightly convex (Pl. III, *C*); gastric and cardiac regions faintly outlined by very shallow grooves; general surface smooth, slightly

roughened on the post-frontal and hepatic areas by granules and rounded tubercles of microscopic size, the latter distributed backward along the branchial border; surface sparsely covered with short yellowish bristles.

Front a little more than one-third the width of the carapace with a broad shallow emargination in the middle line. Supraorbital border slightly raised and with two faint sutures, the lateral one hardly noticeable. Antero-lateral border rounded, confluent with the posterior border; teeth of antero-lateral border inconspicuous, the first, or outer orbital angle, a continuation of the supraorbital border, the second hardly distinguished from the small tubercles of the antero-lateral border, the third, fourth and fifth represented by slightly more prominent and sharper tubercles than those of the general border.

Right cheliped in type specimen (fig. 7, *h*) larger than the left, and twice the length of the carapace. Arm as broad as long, the anterior border with short teeth, outer surface covered with low, rounded tubercles with a few short bristles interspersed. Wrist stout, almost as long as arm, outer and upper surfaces covered by tubercles similar to those of the arm; inner angle with a strong tubercle more prominent than those of the general surface. Numerous bristles are scattered over the outer surface of the wrist.

Palm of hand stout, as wide as the upper border is long; upper and lower borders rounded; upper half of outer and upper part of inner surfaces covered by low rounded tubercles similar to those of wrist and arm; lower half of outer and inner surfaces and lower border smooth. A few bristles are interspersed among the tubercles of the hand. Fingers stout, spoon-like at tips. Movable finger tuberculate at the base, grooved longitudinally, strongly arched, as long as the upper border of the palm and with a stout tooth at the base and one near the middle. Immovable finger with a stout tooth at the base and two smaller ones near the tip. Fingers widely gaping when closed.

Left cheliped in type specimen (fig. 7, *g*) resembling the right except shorter and more slender; tubercles on outer surface of palm relatively larger and disposed in longitudinal series; fingers less strongly arched than in the right cheliped.

Walking legs with upper borders of merus and carpus sharp, the proximal two-thirds of upper border of merus faintly serrate, the entire lower border with low, rounded teeth. Upper border of carpus with sharp granules, lower border smooth; upper and lower borders of propodus and basal portion of dactylus armed with sharp granules or spinules, those on the lower border of dactylus amounting to short, conical teeth which increase in length from basal to distal extremity of portion of border occupied by them. A deep constriction occurs in the lower border of the propodus distal of the middle. Dactylus strongly hooked and slightly longer than the propodus. Long bristles are carried on the upper and lower borders of the segments and the dactylus is well covered by them.

The male of this species differs from the female chiefly in size. The largest of the males collected is slightly smaller than the type specimen. As in all species of the genus, the abdomen of the male shows a fusion of the third, fourth and fifth segments.

Color of type specimen, in alcohol, light brown, base of fingers dark brown, tips white.

This species is readily distinguished from *Chlorodiella niger* (Forskål) and *Chlorodiella laevissima* (Dana), which are nearly identical, by the character of the surface of the carapace and chelipeds which, in the last two species, are comparatively smooth.

Euxanthus minutus, new species. (Fig. 8, *a-d*; Pl. III, *B*.)

Type specimen an ovigerous female: greatest width of carapace 4.5 mm., length 3.5 mm. Type locality, Wake Island, in shallow water. Bishop Museum collections No. 1808.

Front deflexed, not quite one-half the greatest width of the carapace, almost straight, bilobed, the lobes separated from each other in the mid-line by a narrow incision and from the supraorbital borders by shallow depressions. Dorsal surface of carapace subdivided into areas by broad grooves. The lobules of anterior areas of the carapace are prominent, rounded, while those of the posterior region are low and flat (Pl. III, *B*). Three deep parallel grooves traverse the frontal and medial regions in a longitudinal direction, the extra-medial areas being subdivided for about one-half their length. Broad grooves extend diagonally inward to the gastric and cardiac regions from the fourth and fifth antero-lateral teeth, a narrow but distinct ridge forming the posterior border of the groove extending inward from the fifth tooth. Medial two-thirds of supraorbital border prominent, broadly rounded, lateral one-third low and thin, two inconspicuous notches being in the thinner edge.

Antero-lateral border with five teeth, the first being represented by the low, blunt outer orbital angle, the others being broadly triangular, rounded at tips. The third tooth is the most prominent. The entire upper surface of the carapace, including the lobules, grooves and the teeth of the antero-lateral border, is covered with minute, closely set, rounded tubercles.

Medial angle of the sub-orbital border a prominent, rounded lobe. Basal segment of antenna filling the gap between supra and suborbital borders, with the free end deeply excavated for the reception of the flagellum. Flagellum resting in the orbit but shorter than its major diameter. Ventral surface of carapace, including epistomial and pterygostomial regions, covered by rounded tubercles similar to those of the dorsal surface. Exposed surface of merus of outer maxillipeds roughened by tubercles and sharp granules (fig. 8, *a*).

Chelipeds short, stout, in the type specimen the right one is the larger (fig. 8, *b*). Merus of right cheliped as broad as long, inner surface concave, smooth, outer surface strongly convex; upper and lower inner borders sharp, beaded with minute tubercles, and with some hair along the upper border; upper, outer and lower surfaces closely covered with small rounded tubercles similar to those of the carapace. Wrist as long as the merus, upper and outer surfaces pitted and eroded in an irregular manner and closely covered with minute tubercles similar to those of the merus; upper, inner border sharp and marked by three small, tooth-like elevations, the more distal one being the stronger and representing the inner angle of the wrist. Palm of hand slightly longer than broad, inner surface swollen in the middle, covered with minute, smooth tubercles which, near the upper border, become more ridge-like and elongate in a vertical direction. Upper border of palm roughened with three longitudinal rows of irregular elevations between which the surface is pitted and eroded. Midway of the outer surface two parallel, finely tuberculate ridges arch longitudinally across the palm, the tubercles of the upper ridge being slightly larger than those of the lower ridge which continues forward on the surface of the immovable finger. Lower border of hand sharp; entire upper, outer and lower surfaces closely covered with small rounded tubercles. Fingers short, stout, each tuberculate, longitudinally channelled, bluntly pointed, inconspicuously hollowed at the tip, and with two large, rounded teeth.

Left cheliped smaller than right, fingers more slender, less strongly toothed, and more conspicuously hollowed at the tips.

Merus of walking legs a little more than twice as long as broad, upper border sharp and finely serrated; upper border of carpus, propodus and, to a lesser extent, the dactylus with a broad, shallow longitudinal groove; outer surface of propodus traversed longitudinally by a medial ridge, more conspicuous in the second and third

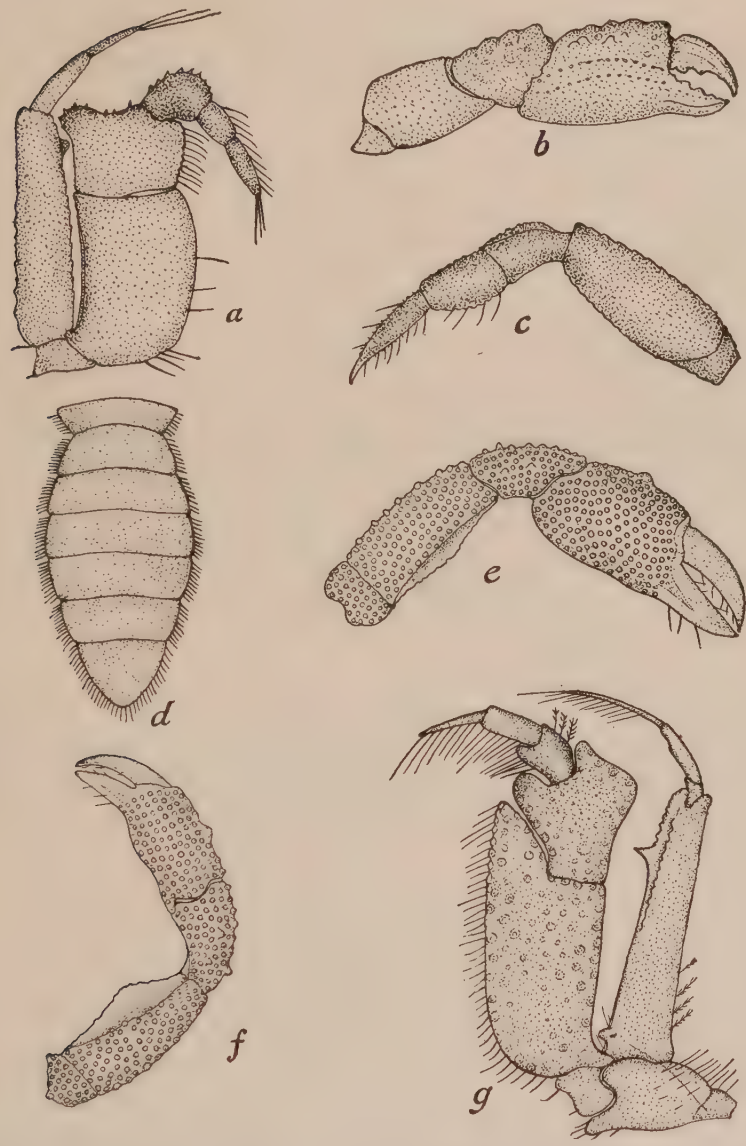

FIGURE 8. *Euxanthus minutus* (*a-d*) and *Palicus tuberculatus* (*e-g*), new species: *a*, outer maxilliped, right side; *b*, right cheliped; *c*, second leg, left side; *d*, telson; *e*, right cheliped; *f*, left cheliped; *g*, outer maxilliped, left side.

legs (fig. 8, *c*). General surface of legs granular with sharp borders finely serrated. Surface of dactyli with numerous spinules and bristles.

A number of species of this genus are recorded by Dana (8, pp. 173-4) and A. M. Edwards (11) from the South Pacific, Australia and the East

Indies. The Wake Island species seems to differ from each of these in the character of the surface of the carapace, the antero-lateral teeth and the markings of the chelipeds.

Cyclodius ornatus Dana.

Cyclodius ornatus Dana, U. S. Expl. Exped., vol. 13, Crust., p. 223, 1852; pl. 12, fig. 11 a-g, 1855: Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 171, 1898.

One specimen was collected at Wake Island. Previous records of the species include the Sulu Sea, Fari Fari, Fakarava, Papeete, and the Tuamotus.

Daira perlata (Herbst).

Daira perlata Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 155, 1898.

Thirty-three specimens were collected at Wake Island which is apparently the only locality of the "Tanager" survey in which the species is represented. Previous records indicate the range of the species to be from Mauritius through the Indian and Pacific oceans to the Liu Kiu islands and eastward to Samoa and Tahiti. It has been taken at Fanning and Palmyra islands but seems not to have reached Hawaii. At Wake Island it is very common on the flat reefs facing the ocean where it conceals itself in the pits and holes of the rough surface.

Xanthias lamarckii (Milne Edwards).

Xanthodes lamarckii Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 157, 1898.

Twenty-six specimens were taken at Wake Island. The species is distributed from Mauritius through the Indian Ocean, and from the Philippines and Australia to the Tuamotus, ranging northward to Fanning and Palmyra islands and Hawaii.

Xanthias notatus (Dana).

Xanthodes notatus Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 158, 1898.

Five specimens were taken at Laysan Island and 15 at French Frigate Shoals. Localities from which the species has previously been reported include Christmas Island and the Nicobars in the Indian Ocean, New Caledonia, Rotuma, the Tuamotus, and Hawaii in the Pacific Ocean. It is not an uncommon species on the reefs of the larger islands of the Hawaiian group.

Xanthias canaliculatus Rathbun.

Xanthias canaliculatus Rathbun, U. S. Fish. Comm. Bull., vol. 23, pt. 3, p. 856, pl. 9, fig. 12, text fig. 17, 1906.

Two specimens were collected at French Frigate Shoals and one at Wake Island. The type specimen was taken at Honolulu in 1901. It is not an uncommon species on Waikiki reef, Oahu. Rathbun also records the species from the Tuamotus.

Lioxantho punctatus (Milne Edwards).

Lioxantho punctatus Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 91, 1898.

Two specimens were collected at Wake Island. The range of the species as previously known included the Indian and Pacific oceans as far as Samoa.

Actaea affinis (Dana).

Actaeodes affinis Dana, U. S. Expl. Exped., vol. 13, Crust., p. 197, 1852; pl. 11, fig. 3, 1855.

In all 117 specimens were taken, the species being a common one at all of the low islands covered by the survey. The species is widely distributed through the Indian Ocean and is known in the Pacific from the Philippines, Australia, and Japan to the Tuamotus. It is very common in Hawaii.

Actaea speciosa (Dana).

Actaea speciosa Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 143, 1898.

Seventeen specimens in all were collected at Pearl and Hermes Reef, Ocean, Laysan, Johnston, and Wake islands. Previous records indicate the range of the species to be from the Persian Gulf through the Indian and Pacific oceans to Guam, Samoa, Funafuti, Palmyra, and Hawaii. There are former records from French Frigate Shoals and Laysan Island of leeward Hawaii. The species has been collected many times on the reefs of Oahu.

Actaea hirsutissima (Rüppell).

Actaea hirsutissima Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 141, 1898.

One specimen was taken at French Frigate Shoals and three at Wake Island. The species is distributed from the Red Sea through the Indian and Pacific oceans to Japan, Australia, Samoa, Rotuma, Tahiti, and Hawaii.

Actaea rufopunctata (Milne Edwards).

Actaea rufopunctata Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 142, 1898.

One specimen was taken at French Frigate Shoals and five at Wake Island. The range is from Mauritius and the Red Sea through the Indian and Pacific oceans to the Tuamotus and northward to Palmyra Island and Hawaii. It has also been reported from St. Thomas and the Cape Verde islands in the Atlantic Ocean.

Actaea cavipes (Dana).

Actaeodes cavipes Dana, U. S. Expl. Exped., vol. 13, Crust., p. 199, 1852; pl. 11, figs. 5a and 5b, 1855.

Thirty-seven specimens were collected at Wake Island where it is apparently very common. The species has a wide range through the Indian Ocean, and localities in the Pacific from which it has been reported include Funafuti, Fiji, Samoa, the Society islands, the Tuamotus, and Palmyra Island.

Actaea alphonsi Nobili.

Actaea alphonsi A. M. Edwards, Mus. Hist. Nat., Paris, Bull., vol. 11, p. 235, 1905.

Two specimens were taken at French Frigate Shoals. Previous records of this species include the Red Sea, Hongkong, and New Guinea.

Actaea variolosa Borradaile.

Actaea variolosa Borradaile, Fauna and Geogr. Maldive and Laccadive archipelagoes, vol. 1, pt. 3, p. 256, fig. 54, 1902.

Two specimens were collected at Laysan Island. The type locality is Male Atoll, Indian Ocean.

Etisodes caelatus Dana.

Etisodes caelatus Dana, U. S. Expl. Exped., vol. 13, Crust., p. 188, 1852; pl. 9, fig. 4 a-d, 1855.

Three specimens were taken at Wake Island which was Dana's type locality. I do not know of other localities for this species.

Etisodes electra (Herbst).

Etisodes electra Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 133, 1898.

One specimen was collected at Johnston Island. The species ranges from the Red Sea through the Indian and Pacific Oceans to Australia, the Tuamotus, Palmyra Island, and Hawaii.

Medaeus elegans A. M. Edwards.

Medaeus elegans A. M. Edwards, Nouv. Arch. Mus. Hist. Nat., vol. 9, p. 211, pl. 8, fig. 1, 1873.

Three specimens were collected at Ocean Island. Edwards records the species from New Caledonia. It has been taken on the reefs of Oahu.

Medaeus simplex A. M. Edwards.

Medaeus simplex A. M. Edwards, Mus. Godeffroy, Journ., vol. 4, p. 79, 1873.

One specimen was collected at Lisiansky and two at Wake Island. Previous records of the species include Madagascar, Samoa and Hawaii.

Medaeus ornatus Dana.

Medaeus ornatus Dana, U. S. Expl. Exped., vol. 13, Crust., p. 182, 1852; pl. 9, fig. 1, 1855.

Two specimens were collected at Ocean Island. Dana's specimen was dredged at Lahaina, Maui. It has been taken on Waikiki reef, Oahu, in shallow water, and also dredged off this reef at depths ranging from 30 to 50 fathoms.

Xanthodius biunguis Rathbun.

Xanthodius biunguis Rathbun, U. S. Fish Comm. Bull., vol. 23, pt. 3, p. 849, pl. 8, fig. 10, text fig. 12, 1906.

In all 208 specimens were collected at Lisiansky, Laysan, Johnston, and Wake islands, 200 of them being taken at Johnston Island where the

species was very common in dead coral blocks and coralline algae heads, both near the shore and on the outer reef. Previous records are from Hawaii.

Leptodius sanguineus (Milne Edwards).

Chlorodius sanguineus Dana, U. S. Expl. Exped., vol. 13, Crust., p. 207, 1852; pl. 11 fig. 11 a-d, 1855.

Thirty-one specimens in all were taken at Necker, Johnston, and Wake islands, 25 of the number being collected at Wake Island. The distribution of the species is very extensive, ranging from the Red Sea through the Indian and Pacific oceans to the Liu Kiu islands, Australia, the Tuamotus, Fanning and Palmyra islands, and Hawaii. There is also a record from Marcus Island. It is exceedingly abundant on the reefs of Oahu.

Leptodius exaratus (Milne Edwards).

Xantho (*Leptodius*) *exaratus* Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 118, 1898.

Two specimens were taken at Laysan Island and 62 at Wake Island. The species ranges from the Persian Gulf through the Indian and Pacific oceans to Japan and Hawaii.

Leptodius exaratus acutidens Stimpson.

Leptodius sanguineus var. *acutidens* Stimpson, Smithsonian Miscellaneous Collections, vol. 49, No. 1717, p. 55, pl. 6, fig. 7, 1907.

Five specimens were collected at Wake Island. Stimpson reported the variety from the Liu Kiu islands. It has also been taken at Fanning and Oahu islands.

Leptodius waialuanus Rathbun.

Leptodius waialuanus Rathbun, U. S. Fish Comm. Bull., vol. 23, pt. 3, p. 848, pl. 8, fig. 9, text fig. 11, 1906.

Two specimens were collected at Ocean Island and one at Johnston Island. The type specimen was taken at Waialua, Oahu, in 1902. Several specimens are in the Bishop Museum, taken on the reefs of Oahu in recent years.

Xantho crassimanus A. M. Edwards.

Xantho (*Leptodius*) *crassimanus* Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 120, 1898.

Two specimens were collected at Necker Island. Previous records include localities in the eastern Indian Ocean, Ceylon, New Caledonia, Australia, Fanning Island, and Hawaii. Numerous specimens have been taken on Waikiki reef, Oahu.

Lophozozymus dodone (Herbst).

Lophozozymus dodone Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 108, 1898.

Twenty-eight specimens in all were collected at Pearl and Hermes Reef, French Frigate Shoals, Ocean, Lisiansky, Laysan, and Johnston islands. The species seems to range from Christmas Island, in the Indian Ocean, to Hawaii.

Lophozozymus pulchellus A. M. Edwards.

Lophozozymus pulchellus A. M. Edwards, Soc. Entom., France, Ann. (4), vol. 7, p. 273, 1867; Mus. Hist. Nat., Paris, Nouv. Arch., vol. 9, p. 205, pl. 7, fig. 3, 1873; Rathbun, Linn. Soc. Trans. 2, vol. 14, p. 214, 1910-1912.

Seven specimens in all were taken at French Frigate Shoals, Lisiansky and Laysan islands. Previous records include the Red Sea, the Seychelles and the Chagos archipelagoes in the Indian Ocean, New Caledonia, Samoa, Fanning Island and Oahu in the Pacific Ocean.

Lophozozymus intonsus (Randall).

Xantho intonsus Randall, Acad. Nat. Sci. Phila. Journ., vol. 8, p. 113, 1840.

Lophozozymus intonsus Rathbun, U. S. Fish Comm. Bull., vol. 23, pt. 3, p. 846, pl. 8, fig. 8, 1906.

One specimen was taken at French Frigate Shoals and one at Laysan Island. Randall described the species from Hawaii where numerous other specimens have been taken in recent years.

Zozymus aeneus (Linnaeus).

Zozymus aeneus Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 104, 1898.

Eight specimens were taken at Wake Island. The range of the species is from the Red Sea through the Indian and Pacific oceans to the Tuamotus and Hawaii, including Guam, Samoa, and Rotuma.

Platypodia eydouxi (A. M. Edwards).

Lophactaea eydouxi A. M. Edwards, Mus. Hist. Nat., Paris, Nouv. Arch., vol. 1, p. 248, pl. 16, fig. 2, 1865.

Sixty-five specimens in all were collected at Lisiansky, Laysan, and Johnston islands, of which 43 were taken at Laysan, where the species is apparently very common. Previous records of the species include the Sulu Sea, Japan, Tahiti, Palmyra Island, and Hawaii.

Platypodia granulosa (Rüppell).

Lophactaea granulosa Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 101, 1898.

Four specimens which correspond closely with descriptions of this species were collected at Wake Island. The range of the species is from Zanzibar and the Red Sea through the Indian and Pacific oceans to Fiji.

Platypodia actoeoides (A. M. Edwards).

Lophactaea actoeoides A. M. Edwards, Mus. Hist. Nat., Paris, Nouv. Arch., vol. 9, p. 189, pl. 7, fig. 7, 1873.

Eleven specimens in all were collected at Pearl and Hermes Reef, French Frigate Shoals, Ocean, Laysan and Wake islands. The type locality of the species is New Caledonia. Lenz reported the species from Laysan Island. There are two specimens in the Bishop Museum, one from the south shore of Molokai and one from Waikiki reef, Oahu, both collected in recent years.

Liomera cinctimana (White).

Liomera cinctimana Alcock, Asiat. Soc. Bengal Journ, vol. 67, p. 88, 1898.

One specimen was taken at Wake Island. The range of the species is from Mauritius and the Red Sea through the Indian and Pacific oceans to the west coast of North America. There are apparently no records for Hawaii. The Bishop Museum has specimens from the Marquesas and Palmyra Island.

Carpilodes monticulosus A. M. Edwards.

Carpilodes monticulosus Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 86, 1898.

Five specimens in all were collected at French Frigate Shoals and Wake Island. The species is known from the Indian Ocean and ranges through the Pacific to the Tuamotus and northward to Hawaii. It is very common on the reefs of Oahu, but apparently is not widely distributed among the leeward islands of the Hawaiian group.

Carpilodes vaillantianus (A. M. Edwards).

Carpilodes vaillantianus Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 85, 1898.

In all 265 specimens were collected at Pearl and Hermes Reef, French Frigate Shoals, Ocean, Lisiansky, Laysan, Johnston, and Wake islands. The species was especially abundant at Lisiansky, Laysan, Johnston, and Wake islands. The range of the species is from Mauritius and the Red Sea through the Indian and Pacific oceans to Fiji, Samoa, Palmyra Island, and Hawaii. It is very common on the reefs of Oahu.

Carpilodes cariosus Alcock.

Carpilodes cariosus Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 86, 1898.

Two specimens, conforming closely to Alcock's description of the species, were collected at Wake Island. The species has previously been reported from a number of localities in the Indian Ocean, and from Palmyra Island in the Pacific Ocean.

Carpilodes supernodosus Rathbun.

Carpilodes supernodosus Rathbun, U. S. Fish Comm. Bull., vol. 23, pt. 3, p. 844, pl. 8, fig. 5, text fig. 6, 1906.

In all 189 specimens were collected at Pearl and Hermes Reef, French Frigate Shoals, Ocean, Lisiansky, and Laysan islands. The species was especially abundant at French Frigate Shoals, Lisiansky and Laysan islands. It is apparently confined to the Hawaiian group of islands. The type locality is Laysan Island, where it was taken by the "Albatross" in 1902. It was also taken on that survey near Nihoa (Motu Manu) at depths from 27 to 31 fathoms. The species, although it has been taken on the reefs of Oahu, is not common there. From the Tanager collections it appears that the species is best developed among the leeward islands of Hawaii.

Carpilodes pallidus Borradaile.

Carpilodes pallidus Borradaile, Zool. Soc., London Proc., 1900, p. 586, pl. 40, fig. 1.

Five specimens were collected at Wake Island. Localities from which the species has previously been reported include the Chagos and Maldive archipelagoes in the Indian Ocean, and Rotuma, Fanning, and Palmyra islands in the Pacific.

Carpilius convexus (Forskål).

Carpilius convexus Alcock, Asiat. Soc. Bengal Journ., vol. 67, p. 80, 1898.

Two specimens were collected at Johnston Island. The species ranges through the Indian and Pacific oceans from the Red Sea to the Tuamotus, Fanning and Palmyra islands and Hawaii. It is common on the reefs of Oahu.

Family GONEPLACIDAE

Libystes villosus Rathbun.

Libystes villosus Rathbun, Biolog. Soc. of Washington Proc. vol. 37, p. 127, 1924.

One specimen was taken on the "Tanager" survey at Wake Island. Rathbun described the species from Samoa, the holotype being a female with the carapace 6.8 mm. long by 11.3 mm. wide. The Wake Island specimen, also a female, is a little smaller, having the carapace 5 mm. long by 8 mm. wide.

Family GRAPSIDAE

Grapsus grapsus tenuicrustatus (Herbst).

Grapsus maculatus var. *tenuicrustatus* Kingsley, Acad. Nat. Sci. Phila. Proc., 1880, p. 193.

Grapsus grapsus tenuicrustatus Rathbun, U. S. Fish Comm. Bull., vol. 23, pt. 3, p. 838, 1906.

Fifteen specimens in all were collected at Laysan, Necker, Nihoa, Gardner, Johnston, and Wake islands. The species is known from Ceylon,

and ranges through the Pacific Ocean from the Bonin Islands to the Tuamotus, Fanning and Palmyra islands, and Hawaii.

Grapsus strigosus (Herbst).

Grapsus strigosus Alcock, Asiat. Soc. Bengal Journ., vol. 69, p. 393, 1900.

One specimen was collected at Johnston Island. The species ranges from the Red Sea through the Indian and Pacific Oceans to Hawaii, one previous record having been from Oahu. A. M. Edwards reported it from New Caledonia, and Rathbun recorded it from Tongatabu.

Grapsus longitarsus Dana.

Grapsus longitarsus Dana, U. S. Expl. Exped., vol. 13, Crust., p. 339, 1852; pl. 21, fig. 4, 1855.

One specimen was collected at Wake Island. Dana's type specimen was from the Tuamotus. Other localities from which the species has been recorded include Funafuti, Hawaii, and between the Galapagos and Mangareva from 300 fathoms to the surface.

Pachygrapsus plicatus (Milne Edwards).

Pachygrapsus plicatus Kingsley, Acad. Nat. Sci. Phila. Proc., 1880, p. 200.

Twenty-six specimens were collected at Johnston Island and two at Wake Island. The species has a wide range from the African coast through the Indian and Pacific oceans to the Tuamotus, Fanning and Palmyra islands, and Hawaii. There is a record from Marcus Island and Lenz reported it from Laysan Island. The Bishop Museum has specimens from Guam.

Pachygrapsus minutus A. M. Edwards.

Pachygrapsus minutus Alcock, Asiat. Soc. Bengal Journ., vol. 69, p. 399, 1900.

Thirty-three specimens in all were taken at French Frigate Shoals, Lisiansky, Laysan, and Johnston islands. The species is known from the Chagos and Mergui archipelagoes in the Indian Ocean. It apparently ranges in the Pacific from New Caledonia northward, at least to Guam and Hawaii.

Metopograpsus messor (Forskål).

Metopograpsus messor Alcock, Asiat. Soc. Bengal Journ., vol. 69, p. 397, 1900.

Twenty-one specimens were collected at Wake Island. The species ranges from the Red Sea and the African shores through the Indian and Pacific oceans at least as far as Tahiti, and northward to Hawaii, including Fanning and Palmyra islands and Hawaii. It has also been reported from the west shore of Africa. The species is not uncommon on the reefs of Oahu, although no specimens were taken on the Tanager Expedition from the leeward islands of Hawaii.

Geograpsus grayi (Milne Edwards).

Geograpsus grayi Alcock, Asiat. Soc. Bengal Journ., vol. 69, p. 395, 1900.

Five young specimens, the largest measuring 20 mm. in breadth of carapace, were taken from the rocky shores of Wake Island, and a still smaller specimen, taken on the same island at some distance from the shore, is probably of this species. The range of this species is from Madagascar and Zanzibar through the Indian and Pacific oceans to Japan, the Bonin Islands, New Caledonia, Australia, and Niue Island. It is recognized as a terrestrial form and may sometimes be found far from the ocean beach.

Cyclograpsus audouinii (Milne Edwards).

Cyclograpsus audouinii Dana, U. S. Expl. Exped., vol. 13, Crust., p. 359, 1852; pl. 23, fig. 2, 1855.

Thirty-eight specimens were collected at Wake Island. Previous localities from which the species has been reported include New Guinea, Australia, Fanning and Palmyra islands.

Percnon planissimum (Herbst).

Leiolophus planissimum Alcock, Asiat. Soc. Bengal Journ., vol. 69, p. 439, 1900.

Five specimens were collected at Wake Island. The species is widely distributed from the Red Sea through the Indian Ocean, and in the Pacific ranges from Japan to the west coasts of North and South America. It is also known in the warmer waters of the Atlantic from Brazil through the West Indies to southern Europe, and the western and southern shores of Africa. It is very common on the reefs of Oahu, but is not represented among the Tanager collections from the leeward islands of Hawaii.

Percnon abbreviatum (Dana).

Acanthopus abbreviatus Dana, U. S. Expl. Exped., vol. 13, Crust., p. 373, 1852; pl. 23, fig. 11, 1855.

Two specimens were collected at Ocean Island and eight at Wake Island. Previous records of this species include localities in the Indian Ocean, and Tahiti, Fanning Island, and Hawaii.

Plagusia depressa tuberculata Lamarck.

Plagusia depressa var. *squamosa* Alcock, Asiat. Soc. Bengal Journ., vol. 69, p. 437, 1900.

Eighteen specimens in all were collected at Lisiansky, Laysan, Gardner, and Necker islands. The species is known from the Red Sea and from Mauritius through the Indian and Pacific oceans to Hawaii.

Planes cyaneus Dana.

Planes cyaneus Dana, U. S. Expl. Exped., vol. 13, Crust., p. 347, 1852; pl. 22, fig. 1, a-g, 1855.

One specimen was collected off Laysan Island in 15 fathoms. Dana states that the species was very abundant in the Pacific, latitude 28° N., longitude 174°, on May 18, 1841, and that one specimen was taken in the South Pacific, latitude 15° 50′, longitude 105°, on July 26, 1839.

Family PALICIDAE

Palicus tuberculatus, new species. (Fig. 8, *e-g*; Pl. IV.)

Type specimen a female; length of carapace 9 mm., breadth 12 mm., front 4.5 mm. Type locality, Ocean Island, in shallow water on the reef.

Bishop Museum collections No. 1134.

Carapace broader than long, dorsal surface convex in both directions, marked by elevations and ridges separated by broad, shallow grooves (Pl. IV, *A*). Three ridges cross the carapace transversely, one through the gastric region, one through the cardiac region and the third near the posterior border, those passing through the gastric and cardiac regions being subdivided medially by shallow, longitudinal furrows. The entire surface, exclusive of the grooves, is covered by closely placed tubercles of unequal size. In addition to the tubercles, the surface is densely covered by a pile of short, feathered hairs, filling the grooves and dispersed between the tubercles but not concealing the latter.

Front deflexed, border with four short, rounded teeth separated by shallow grooves, the median pair more prominent and on a lower level than the lateral ones which are removed from the tumid supraorbital borders by deep broad grooves. Supraorbital border with two fissures.

Antero-lateral border of carapace marked by five bluntly pointed teeth, inclusive of the small, outer orbital tooth. The second of the five teeth consists of a prominent tubercle somewhat more pronounced than the outer orbital tooth and separated from it by a narrow, shallow groove. Below this second tooth and separated from it by a slight depression is another tuberculate elevation of equal size. Third tooth more prominent than the second, broad and low, with a supplementary tubercle in front and behind it. The fourth tooth is the largest of the five, broadly triangular, with a tubercle in front and behind; fifth tooth is as long as the fourth but narrower. Postero-lateral border of carapace about equal in length to the antero-lateral, and irregularly tuberculate.

Eyestalk short, thick, tuberculate above, the upper base of the ocular portion and the outer half of the orbit fringed with short, stiff hairs. Suborbital border marked by two broad, deep fissures, the inner separating two prominent lobes, conspicuous from above. The pterygostomial region is marked by a broadly rounded lobe projecting ventrally.

Basal segment of antenna broadly joined to the supraorbital border excluding the flagellum from the orbit. Ischium of external maxilliped with antero-lateral border extending well beyond the articulation with the merus; merus a little longer than broad, deeply excavated for the reception of the palp.

Abdomen in type specimen (Pl. IV, *B*) of seven segments closely covered by rounded tubercles of nearly uniform size, interspersed with short hairs. The first three segments are indistinctly crested by rows of tubercles in transverse series; seventh segment triangular with tip smooth.

Under surface of carapace, external maxillipeds (fig. 8, *g*) and basal segments of antennae tuberculate, most of the tubercles being of smaller size than those of the

abdomen. Under surface everywhere is covered with a short pile similar to that of the dorsal surface.

Chelipeds (Pl. IV, *C*) in type specimen unequal, the right being the larger. Proximal two-thirds of lower border of arm roughened by irregularly placed tubercles. Inner angle of wrist represented by a blunt tubercle; entire outer surface of arm, wrist and palm covered with smooth, rounded tubercles of uniform size (fig. 8, *e, f*) between which is a dense coating of short hairs similar to that of the carapace. A prominent swelling occurs on the outer surface of the palm close to the upper border. Inner surface of palm full, smooth, with a few scattered hairs below the middle. Fingers compressed, shorter than palm, longitudinally channelled on upper and outer borders, tips pointed, crossing when closed, cutting edges thin, smooth; medial surface of fingers with rows of long, stiff bristles.

First three walking legs (Pl. IV, *D*) differ but slightly from each other, the first being the smallest of the three. Merus a little more than half as broad as long, surfaces tuberculate, the posterior surface of the first and the anterior surface of the second and third legs smoother; lower border of merus roughly dentate, upper border with several blunt teeth and a rounded terminal lobe. The upper border in the first leg is smoother than that of the second and third. Upper anterior border of carpus terminating distally in a blunt tooth; upper posterior border with a longitudinal ridge, at the base of which is a row of long, feathered bristles. Propodus elongated, compressed, crested above, the posterior border of the crest with a row of long, feathered bristles; anterior and posterior surfaces of segment longitudinally channelled, the grooves filled with short hairs; lower border with a row of short spines. Dactylus compressed, with a row of long, feathered bristles near upper, posterior border and two small spines on lower border. Fourth walking leg (Pl. IV, *D*) very slender, roughened by irregularly placed tubercles; ischium three-fourths as long as merus and nearly as long as carpus.

A male specimen of this species taken by the Tanager Expedition at Ocean Island is slightly smaller than the type specimen, having a carapace 8 mm. in length and 10 mm. in breadth. The chelipeds in the male (Pl. IV, *G*) are larger than in the type specimen; the fingers, especially of the right hand, are more deflexed and the inner surface of the palm in both chelipeds is almost completely covered with a mass of long, finely branched hairs.

In addition to the two specimens collected at Ocean Island there are three other specimens in the Bishop Museum, a male and a female taken in dead coral heads on Waikiki reef, Oahu, and a female collected in shallow water on the south side of Molokai. Another specimen is in the United States National Museum, taken on the reef between Waikiki beach and Honolulu harbor by J. C. Bridwell.

This species is apparently distinguished, by important features of the carapace, chelipeds, walking legs and abdomen, from other recorded species of the Indo-Pacific area including *P. jukesii* (White) (5, p. 29, pl. 1, figs. 9-13), *P. whitei* (Miers) (22), *P. serripes* (Alcock and Anderson) (2), and from both *P. fisheri* and *P. oahuensis* described by Rathbun (23) from Hawaiian waters.

Family OCYPODIDAE

Ocypode ceratophthalma (Pallas).

Ocypode ceratophthalma Alcock, Asiat. Soc. Bengal Journ., vol. 69, p. 345, 1900.

Sixty-six specimens in all were collected at Pearl and Hermes Reef, French Frigate Shoals, Ocean, Laysan, Nihoa, and Johnson islands. The species ranges through the Indian and Pacific oceans from Mauritius and the Red Sea to the Tuamotus and Hawaii. It is a common inhabitant of sandy beaches.

Uca tetragonon (Herbst).

Gelasimus tetragonon Alcock, Asiat. Soc. Bengal Journ., vol. 69, p. 357, 1900.

Ninety specimens were collected at Wake Island. The range of the species is reported as being from Mauritius and the Red Sea through the Indian and Pacific oceans eastward to the Society islands and northward to Hawaii. Kingsley recorded the species from Hawaii, but I know of no other specimens having been taken in this locality. Conditions are not suitable for the "fiddler crab" on Johnston Island, but on Wake Island the species is very numerous on the sand flats at the eastern end of the lagoon.

Order STOMATOPODA

Family CHLORIDELIDAE

Pseudosquilla ciliata Miers.

Pseudosquilla ciliata Miers, Ann. and Mag. Nat. Hist., ser. 5, vol. 5, p. 108, pl. 3, figs. 7, 8, 1880: Kemp, Indian Mus. Mem., vol. 4, p. 96, 1913.

One specimen was collected at Wake Island. Previous records indicate a wide range for the species, its description in the Indian and Pacific oceans extending from Mauritius to Hawaii. It is also known in the Atlantic from the Bahama islands, the Florida Keys and Porto Rico. It is a common species on the reefs of Oahu.

Pseudosquilla oculata (Brullé).

Pseudosquilla oculata Kemp, Indian Mus. Mem., vol. 4, p. 102, 1913.

Sixty-eight adult specimens, in addition to one hundred and sixty-five larvae of the "monodactyla" stage probably of this species, were collected on the Tanager Expedition at the following localities: Pearl and Hermes Reef, French Frigate Shoals, Ocean, Lisiansky, Laysan, Johnston, and Wake islands. One hundred specimens of the larval stage were taken at night by means of a tow net near Pearl and Hermes Reef. Sixty-four similar specimens were taken in a like manner, also at night, from the surface about two miles off Johnston Island. The species has a very wide range from Mauritius through the Indian and Pacific oceans. It has also

been reported from the Atlantic in the vicinity of Madeira and the Cape Verde Islands.

Gonodactylus chiragra (Fabricius).

Gonodactylus chiragra Kemp, Indian Mus. Mem., vol. 4, p. 155, pl. 9, fig. 107, 1913.

Seven specimens were collected at Wake Island. The range of the species is throughout the Indian Ocean, and in the Pacific previous records indicate its distribution from Australia to Japan and Tahiti. It has been reported from Palmyra Island, but I do not know of any records from Hawaii.

Order COPEPODA

Family CALIGIDAE

Alebion gracilis Wilson.

Alebion gracilis Wilson, U. S. Nat. Mus. Proc., vol. 31, p. 704, pl. 18, figs. 35-48, 1907.

Eight specimens were taken from a shark at French Frigate Shoals. The species is recognized as a fairly common parasite on sharks in the Atlantic Ocean, but Wilson states (27) that this is the first record of its observation in the Pacific.

Order PHYLLOPODA

Family BRANCHIPODIDAE

Artemia gracilis Verrill.

Artemia gracilis Verrill, Am. Journ. Sci., 2nd ser., vol. 48, p. 248, 1869: Packard, U. S. Geolog. and Geograph. Survey of the Territories, 12th Ann. Rept., pt. 1, p. 330, Pl. 8, figs. 1-5, text figs. 17, 18, 1882.

Many thousands of specimens of an Artemia, which closely conforms to the description of *A. gracilis,* were taken in the lagoon at Laysan Island where they appeared to be distributed throughout its waters from the surface to the greatest depth of about 23 feet, but occurred in greater numbers in the shallows near the shore where they were crowded into dense masses.

According to Packard, *A. gracilis* is widely distributed in the United States proper, ranging from Massachusetts to California. Eric Schlemmer of Honolulu, who was born on Laysan Island, states, in a personal communication, that Artemia was abundant in the lagoon at Laysan more than 20 years ago.

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SEA STARS

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INTRODUCTION

The sea stars procured by the Tanager Expedition admirably illustrate the value of general collecting. Although the Albatross Expedition of 1902 covered much of the region visited by the Tanager Expedition (with the exception of Wake and Johnston islands), the "Tanager" added to the Hawaiian fauna the following forms not obtained by the "Albatross": *Astropecten triseriatus myobrachius, Dactylosaster cylindricus pacificus, Acanthaster planci, Coscinasterias acutispina.* A new Ferdina was taken at Wake Island, and the range of *Asterina cepheus* greatly extended by the capture of specimens. At Johnston Island *Linckia multifora* was collected.

A number of specimens not a part of the Tanager collection are recorded: chiefly, two Culcitas from Pearl Harbor, one of them a new forma; a new Leiaster from Kauai; two new records from Palmyra, greatly extending the range of the species, *Asterina coronata cristata* and *Othilia luzonica,* which have not yet been taken in the Hawaiian islands; and finally a new Coronaster from Penguin Bank, south of Oahu, dredged by the "Albatross" in 1902.

In my report on the starfishes collected by the Albatross Expedition of 1902 (4), the relationships of the fauna were stated to be principally with the East Indian and Indian Ocean faunas, and to a less degree with the Japanese and Australian.

Since then the case has been greatly strengthened by the publication of Koehler's account of Indian Ocean Asteroidea (7) and by the large collections made by the Albatross Expedition in Philippine waters (5).[3]

The following Hawaiian species have been encountered in the Indian Ocean: *Cheiraster snyderi, Cheiraster inops, Pseudarchaster jordani, Mediaster ornatus, Hymenaster pentagonalis, Craterobrisinga panopla.* The *Albatross* dredged the following Hawaiian species[4] in the East Indies: *Dipsacaster nesiotes* (Moluccas), *Cheiraster inops* (Philippines), *Pseudarchaster jordani* (Borneo, Moluccas), *Mediaster ornatus* (Philippines), *Brisingella fragilis* (Philippines).

[3] The very rich collections of the Siboga Expedition should also be mentioned. The report is not yet completed but five sumptuous fascicles by Doderlein (3) have already been issued.

[4] *Sclerasterias euplecta* [*Distolasterias euplecta*] listed in my Philippine report I now conder a variant of *hypacantha* which is a subspecies of the Hawaiian *euplecta.*

The following dredged Hawaiian species have their nearest known relatives in the East Indian and Indian Ocean regions:

Astropecten pusillulus (*A. eremicus,* Philippines)
Ctenophoraster hawaiiensis (*C. diploctenius,* Philippines)
Persephonaster cingulatus (*P. multicinctus,* Celebes)
Tritonaster craspedotus (*T. evorus,* Philippines)
Dipsacaster nesiotes (*D. imperialis,* Philippines; *D. sladeni,* Andaman Sea)
Patagiaster nuttingi (*P. sphaerioplax,* Philippines)
Luidia hystrix (*L. aspera,* Philippines, Admiralty Islands)
Cheiraster inops (*C. niasicus,* Philippines, Celebes, Moluccas)
Cheiraster snyderi (*C. gazellae,* Philippines, Indian Ocean)
Sphaeriodiscus ammophilus (*S. scotocryptus,* Philippines)
Astroceramus callimorphus (*A. lionatus* and *A. sphaeriostictus,* Philippines)
Calliaster pedicellaris (*C. corynetes,* Philippines)
Anthenoides epixanthus (*A. granulosus,* Moluccas)
Evoplosoma forcipifera (*E. augusti,* Ceylon)
Asterodiscus tuberculosus (*A. elegans,* Philippines)
Coronaster eclipes (*C. volsellatus,* Philippines)
Sclerasterias euplecta (*S. euplecta hypacantha,* Philippines)
Odinia pacifica (*O. magister,* Philippines)
Craterobrisinga alberti (*C. eucoryne,* Philippines)
C. panopla (*C. parallela,* off Ceylon)

The very rare *Calliderma emma,* believed to be from Japan, has its only known relative in the beautiful *C. spectabilis* of the Hawaiian plateau. *Coscinasterias acutispina* is a Japanese species here recorded for the first time, from Pearl and Hermes Reef and Ocean Island. *Luidia magnifica* appears to be closely related to *L. maculata* of the Japanese, East Indian, north Australian, and Indian Ocean faunas.

Of the Australian elements in the fauna the most striking is *Astropecten triseriatus myobrachius,* a new race of a long known species. Other species which might be listed are wider ranging forms. However the new Ferdina from Wake Island introduces an Australian element to the near neighborhood of the archipelago.

Of the species listed by me in 1906 (4) as common to the Hawaiian islands and the west coast of America, only *Mithrodia bradleyi* is definitely known from specimens, the locality of which is not open to doubt. Döderlein has synonymized *Oreaster hawaiiensis* with *O. occidentalis,* Pacific coast of Mexico, and *O. cumingii,* Ecuador. I am familiar with *O. occi-*

dentalis which is probably the same species as *cumingii*. But as I pointed out (4), *hawaiiensis* has different growth stages from *occidentalis*, of which Stanford University possesses a good series. The young of this species are more spiny than the adult, while in *hawaiiensis* the reverse is true. In the latter, if any spines are present in the young they are inconspicuous and are confined to the median-radial line. *Hawaiiensis* is probably not related closely to the American form, but to the Asiatic *orientalis*-section.

It may be useful to list Hawaiian species widely distributed through Oceania and the Eastern Archipelago, some of them reaching Australia, Japan, and the Indian Ocean:

Astropecten polyacanthus
Archaster typicus
Culcita novaeguineae
Asterope carinifera
Gomophia aegyptiaca (?)
Linckia multifora (Johnston Island)
Linckia guildingii
Ophidiaster lorioli
Ophidiaster squameus
Valvaster striatus
Acanthaster planci

Valvaster striatus needs especial mention. The only other record is Mauritius. Two new forms, *Leiaster leachii hawaiiensis* and *Dactylosaster cylindricus pacificus* are eastern races of long known species. *Leiaster leachii* is found at Mauritius, Amirante, the Seychelles, Coetivy Reef, and Mozambique. *D. cylindricus* is found at Portuguese East Africa, Muscat, and Mauritius. The Fiji record may refer to *pacificus*.

Certain genera found in the East Indian-Polynesian-Australian area are not represented in the Hawaiian fauna, notably genera of Porcellanasteridae and Goniopectinidae: Craspidaster, Astromesites, Ctenopleura, Koremaster, Benthopecten, Radiaster, Aphroditaster, Paragonaster, Perissogonaster, Rosaster, Nymphaster, Pontioceramus, Lithosoma, Iconaster, Goniodiscaster, Ogmaster, Stellaster, Anthenea, Choriaster, Nardoa, Gomophia (doubtful), Ferdina (Wake), Bunaster, Metrodira, Patiriella, Nepanthia, Othilia, Solaster, Crossaster, Lophaster, Retaster, Diplopteraster, Cnemidaster, Pholidaster, Freyella, Freyellaster, Astrostephane, Stegnobrisinga.

Such species as *Linckia laevigata, Asterina cepheus* (Wake), *Asterina coronata cristata* (Palmyra), and *Othilia luzonica* (Palmyra) are certainly to be expected but have not yet been taken. The absence of Nardoa is especially noteworthy.

CHECK-LIST OF HAWAIIAN SEA STARS[5]

ASTROPECTINIDAE

Astropecten polyacanthus M. and T.
Astropecten triseriatus myobrachius.
Astropecten hawaiiensis Döderlein (=*A. velitaris* Fisher, 4, not von Martens).
Astropecten ctenophorus.
Astropecten callistus.
Astropecten pusillulus.
Astropecten productus.
Ctenophoraster hawaiiensis.
Tritonaster craspedotus.
Psilaster attenuatus.
Persephonaster cingulatus (=*Psilasteropis cingulata*).
Dipsacaster nesiotes.
Patagiaster nuttingi.

LUIDIIDAE

Luidia hystrix.
Luidia magnifica.

BENTHOPECTINIDAE

Cheiraster inops.
Cheiraster snyderi.
Luidiaster horridus (=*Cheiraster horridus*).

ARCHASTERIDAE

Archaster typicus.

GONIASTERIDAE

Pseudarchaster jordani.
Pseudarchaster myobrachius.
Mediaster ornatus.
Ceramaster bowersi (=*Nereidaster bowersi*).
Ceramaster micropeltus (=*Tosia micropelta*).
Plinthaster ceramoideus (=*Tosia ceramoidea*).
Sphaeriodiscus ammophilus (=*Pentagonaster ammophilus*).
Calliderma spectabilis.

[5] Where the authority is omitted, Fisher (in most cases 4) is understood. The name in brackets following the current name is the one used in 4.

Astroceramus callimorphus.
Calliaster pedicellaris.
Gilbertaster anacanthus.
Evoplosoma forcipifera.
Anthenoides epixanthus (*Antheniaster epixanthus*).

OREASTERIDAE

Oreaster hawaiiensis (*Pentaceros hawaiiensis*).
Asterodiscus tuberculosus.
Culcita novaeguineae forma **arenosa** (Perrier).
Culcita novaeguineae forma **nesiotis.**
Culcita novaeguineae forma **novaeguineae,**[6] (M. and T.), Johnston Island.

ASTEROPIDAE

Asterope carinifera (Lamarck) (=*Gymnasteria carinifera*).

LINCKIIDAE

Fromia pacifica H. L. Clark.
Gomophia aegyptiaca Gray (?) (=*Nardoa aegyptiaca*).
[**Ferdina cancellata tylota,** Wake Island].
Linckia multifora (Lamarck) Johnston Island.
Linckia guildingii (Gray) (=*Linckia diplax*).
Leiaster callipeplus.
Leiaster leachii hawaiiensis.
Leiaster brevispinus Clark.
Ophidiaster rhabdotus.
Ophidiaster squameus.
Ophidiaster lorioli.
Dactylosaster cylindricus pacificus.
Tamaria tenella (=*Ophidiaster tenellus*).
Tamaria scleroderma (=*Ophidiaster sclerodermus*).
Tamaria triseriata (=*Ophidiaster triseriatus*).

ASTERINIDAE

[**Asterina cepheus** (M. and T.), Wake Island].
Asterina granulosa Perrier (?)[7]
Anseropoda insignis.

[6] *Goniodiscides sebae (Goniodiscus sebae)* is the young of *Culcita novaeguineae.* The young ages of the different formae have not been well differentiated.

[7] Although this species was described as from the Sandwich Islands, it has not since been found.

GANERIIDAE[8]

Hyalinothrix millespina.

ECHINASTERIDAE

Henricia robusta.
Henricia pauperrima.

VALVASTERIDAE

Valvaster striatus (Lamarck)

MITHRODIIDAE

Mithrodia bradleyi, Verrill

ACANTHASTERIDAE

Acanthaster planci (Linnaeus).

MYXASTERIDAE

Asthenactis papyraceus.

PTERASTERIDAE

Pteraster reticulatus.
Hymenaster pentagonalis.
Benthaster eritimus.

ZOROACTERIDAE

Zoroaster spinulosus.

ASTERIIDAE

Coscinasterias acutispina (Stimpson).
Sclerasterias euplecta (=*Coscinasterias euplecta*).
Tarsastrocles verrilli (=*Hydrasterias verrilli*).
Coronaster eclipes.

BRISINGIDAE

Odinia pacifica.
Craterobrisinga panopla (=*Brisinga panopla*).
Craterobrisinga alberti (=*Brisinga alberti*).
Craterobrisinga evermanni (=*Brisinga evermanni*).
Brisingella fragilis (=*Brisinga fragilis*).

[8] The family position of this curious species is obscure. (See Fisher, U. S. Nat. Mus., Proc., vol. 39, 1911, pp. 659-664, pls. 69-71.)

TAXONOMY

Family ASTROPECTINIDAE

Astropecten polyacanthus Müller and Troschel.

Astropecten polyacanthus Müller and Troschel, System der Asteriden, 1842, p. 69, pl. 5, fig. 3; Fisher (4), p. 1004, pl. 1, fig. 1, pl. 2, figs. 1, 1a-1b; Döderlein (3), 1917, p. 134, pl. 4, figs. 4, 5, pl. 12, figs. 4, 5.

One specimen, No. 135, French Frigate Shoals.

A single specimen of this well-known species was dredged by the "Albatross" in 1902 at station 4168, off Nihoa, 20 fathoms. It is easily recognized by the row of prominent, erect, superomarginal spines, lacking from the second, or second and third plates. Figures of typical examples are given by Fisher and Döderlein (3, 4).

Astropecten triseriatus myobrachius, subsp. nov. (See Pl. V, *B*.)

Diagnosis. Differing from *A. triseriatus* Müller and Troschel, of Australia, in having shorter rays and the three inferomarginal spines about equally sharp. R41 mm., r 12 mm.; R=3.4r; breadth of ray at base, 12.5 to 12 mm.

Description and figures of *A. triseriatus* (including the type) are given by Döderlein (3, 1917, p. 125, pl. 5, figs. 2, 3; pl. 11, figs. 5, 6, 6a). The Hawaiian race is closely similar except in regard to the length of the ray, which is notably shorter and stubbier. Across the base of the ray are about 14 paxillae having ten to twelve cylindrical round-tipped spinelets, of which one or two occupy the center. On a few paxillae a central spinelet is greatly enlarged. Superomarginal plates 20 or 21, the first and second or first to fourth with one spine; then follow three to seven plates with two spines, the remainder with three (rarely, four) in an oblique transverse series along the crest of the strongly convex plates, which are not closely covered with flattened spinelets. These are slender on the margin of plate, gradually changing to larger, blunt, lanceolate-ovate scales at the bases of the spines. Terminal plate conspicuous with a dorsal median sulcus continuous with the end of the ambulacral groove, which is here bounded on either side by a longiseries of three or four short conical spines.

Inferomarginal spines in a transverse comb of four on the first four or five plates; then either three or four on a few plates; then three. The upper spine is 2.5 plates in length (4.5—5 mm.), rather flattened and sharp; the next is similar, 3.5 mm. long, and close under the first; then a slight space and the third spine, similar to the second, but three mm. long. The fourth, when present, is blunter and rather obtuse. The spinelets are elongate, spatulate, rounded or subtruncate and are largest around the base of the spines.

Furrow spines three, rather long; then two, rather slender, flat, round-tipped suborals, of which the aboral is slightly the broader; then two (or one) similar but smaller spines. Two actinal plates, on either side of the interradial line, each armed with a tuft of slender blunt spinelets.

Color in alcohol, light brown.

Type. Pearl and Hermes Reef, Tanager Expedition.

Remarks. There is apparently no record of triseriatus except from Australian waters. The occurrence of a closely related race among the Hawaiian islands carries interesting implications of zoogeographic relationship between the two regions.

Family LUIDIIDAE

Luidia hystrix Fisher.

Luidia hystrix Fisher, 1906, p. 1032, pl. 13, figs. 1, 2; pl. 14, figs. 1, 2; pl. 16, figs. 2, 2a.

One specimen, Pearl Harbor, Feb. 9, 1902.

The type of this species was taken by the Albatross Expedition of 1902 in Auau Channel, between Maui and Lanai, in 28 to 43 fathoms, and the species was dredged at six other stations from Penguin Bank, south of Oahu, to Nihoa, in 20 to 55 fathoms.

The species has eight rays and is rather closely related to *L. aspera* Sladen of the Philippines. Both are related to the predominantly seven-rayed *L. savignyi,* of the western Indian Ocean. Possibly they are geographical races of that long-known form.

Family OREASTERIDAE

Genus CULCITA Agassiz

Every new specimen of Culcita seems to augment rather than relieve the difficulties relative to the species problem. Döderlein's excellent photographic figures (2) in his revision furnish a standard with which specimens may be compared, but unfortunately he has been able to picture only a few of the bewildering array of variations. Without any intention of exhibiting assurance concerning a matter wherein angels may evince a becoming reticence, I would suggest that Linnaean species do not exist in this and in several other genera of Asteroidea. *Culcita novaeguineae* appears to be in a state of flux, possibly due to the effects of hybridization of species formerly separated by barriers which do not now exist. Whatever the nature of these barriers, the mingling of previously separated species might be attributed to a general subsidance and obliteration of large land masses in the Pacific-East Indian area. That the Hawaiian islands represent the fragments of such a land mass is the opinion of a number of competent biologists. The effect of a general obliteration of large land areas upon the course of ocean currents would be marked. The result would be sure to affect the distribution of many species. A land mass, by keeping separated two or more ocean thoroughfares for the dispersal of larvae, would act as a barrier.

CULCITA NOVAEGUINEAE Müller and Troschel

Forma NOVAEGUINEAE

Variety *typica* Döderlein 1896, p. 315, pl. 19; figs. 3, 3*a*.

There is one specimen from Johnston Island which, when dried, has R 77 mm. The contour, which is pentagonal and swollen interradially, and

the armature of the abactinal surface are closely similar to Döderlein's figure 3, but the numerous spines of the papular areas are relatively a little larger, possibly more nearly as in figure 7. The whole abactinal and lateral surfaces are closely covered with sharp conical spines arising from a close, fine, conical granulation, among which are numerous pedicellariae having two upright jaws, higher than wide, with the broadened, rounded tops bent tong-like toward one another. These rise well above the granulation. The actinal surface is very similar to that of the same specimen figured by Döderlein (2, fig. 3*a*).

Forma ACUTISPINOSA (Bell)

Culcita acutispinosa Bell, Ann. and Mag. Nat. Hist. (ser. 5), vol. 12, p, 344.
Culcita novaeguineae var. *acutispinosa* Döderlein, 1896, p. 315, pl. 20, fig. 8, 8*a*.

One specimen, Agaña, Guam, Alvin Seale, collector, June 3, 1900. This when dried has R 70 mm. Abactinally it is most like Döderlein's figure 8 (2). The spines are nearly uniform, sharp-conical, about the size of the largest of forma *novaeguineae,* are fewer and consequently much more widely spaced. The papular areas are everywhere confluent and the granules average slenderer than in the Johnston Island specimen. The pedicellariae are smaller with narrower jaws.

The actinal surface is unlike any of Döderlein's figures. The inner part of each interradial angle is much as in figure 1*a* (plana) but at the border adjacent to inferomarginal plates the tubercles flatten, broaden, and form a crowded, irregularly polygonal, flat tessellation, each tubercle much broader than toward the mouth angle and so closely crowded that the granules disappear.

Forma ARENOSA Perrier

Plate VI

Culcita arenosa Perrier, Recherches sur les Pedicellaires, 1869, p. 66. Rév. des Stell., 1875, p. 264 (Sandwich Islands).
Culcita novaeguineae var. *arenosa* Döderlein, 1896, p. 315, pl. 19, figs. 5, 6.

One specimen, Pearl Harbor, Oahu, No. 164. The original type was collected by the expedition of Eydoux and Souleyet in the *Bonite* in 1837, "des iles Sandwich." The specimen in hand, having a radius when dried of 106 mm., is arcuately pentagonal and agrees closely with Döderlein's figure 3, representing a specimen from the Hawaiian islands.

The papular areas are freely confluent so that the papulae appear to be uniformly distributed over the abactinal surface and well down on the sides of the body (in the middle of the lateral face of "ray", as far as the inferomarginal plates). This extensive sieve area is covered with rather uniform, very small, tapering, pointed, well-spaced spinelets. The skin is covered by a close granulation of very fine, tapering, sharp spinelets, a little longer than those on the Johnston Island specimen (*novaeguineae*). There are numerous two-jawed, slender pedicellariae longer than the fine

spinelets, and one-third or one-half the length of major spinelets. They have slender, pedicellariae longer than the fine spinelets, and one-third to one-half the length of major spinelets. They have slender, terminally spatulate, round, incurved jaws.

Clark (1, p. 32) believes that the species at Hawaii is distinct from that at Erub and Mer, Murray Islands, Torres Strait, recorded as *novaeguineae*. This may well be so. I have recorded *arenosa* as a forma to save confusion and until some one is fortunate enough to point out characters by which the apparent intermediates can be allocated. It would not be difficult to derive the Johnston Island form from *arenosa* by a differential growth of the abactinal spines, by which those standing between the papular areas would grow more rapidly than those of the poriferous areas. In both specimens the papulae extend to the inferomarginal plates. The following form appears to be more different from *arenosa* than is the typical form of *novaeguineae*, as interpreted by Döderlein (2, fig. 3, 3*a*). It is wholly unlike *arenosa* and indicates that the Culcita fauna of the Hawaiian islands is anything but homogeneous.

Forma NESIOTIS forma nov.

Plate VII

Diagnosis. Differing from forma plana in having the papular areas confluent all over the abactinal area so that the tubercles are surrounded by pores and there is no visible network of pore-free tracts; differing from *C. schmideliana* in the absence of abruptly enlarged granules or tubercles on the actinal intermediate plates and in the presence of small tubercles on the pore areas.

Description of type. R 80 mm. Form pentagonal, somewhat produced at corners. Whole abactinal surface as far as upper margin of superomarginal plates, closely covered with pores, except for two small islands, in each interradius, along the interradial line. The inner island of one interradius contains the madreporite. Surface beset with well spaced, unequal tubercles, the larger 1 to 1.5 mm. in diameter, low acorn-shape, or convex, and sometimes arranged in triangles (but each completely surrounded by pores). Much smaller, sub-globular, hemispherical or acorn-shaped tubercles are scattered far apart between the larger. These are of various sizes, some only slightly larger than the fine granules (of the same general form as the tubercles) which cover the skin. There are a few pedicellariae, resembling a cylindrical granule or short tubercle split lengthwise, slightly larger than the ordinary granules.

The actinal surface resembles somewhat Döderlein's figure 9, the position of the plates showing as convexities. The surface is covered with a coarse, flat, irregularly polygonal, tessellated granulation, the largest granules being toward the center of the convexities and the margin of the disk. The larger granules are 1.5 mm. broad; the smaller, 0.25 to 0.5 mm. Actinal pedicellariae resembling small split granules are rather numerous near the furrow.

The marginal plates, free of spines and papulae, are covered by convex granules which increase in size as the actinal surface is approached. Some of the large flat granules of the actinal surface are scattered over the inferomarginal plates and the last dozen have a definite, low tubercle or two in the middle of the plate, similar to the subambulacral tubercles, of which there are in this region two or three (sometimes one) in a transverse series. At the upper edge of some of the superomarginal plates adjacent to the papulae is a depressed hemispherical granule similar to those scattered over the abactinal area. A few pedicellariae, like split granules, occur here and there on the inferomarginals.

Furrow spines usually five, sometimes four or six; they have three or four sides at variable angles. Back of these are two or three low, unequal, subtruncate tubercles, broader than high, irregular as if by mutual contact; external to these are one or two other smaller tubercles.

Type. Bishop Museum collections. Type locality, Pearl Harbor, Oahu.

Remarks. By ordinary standards this forma would be considered specifically distinct from *arenosa*. *Arenosa* bears somewhat the same relation to forma *novaeguineae* (Döderlein, 2 fig. 3) that *nesiotis* bears to forma *plana* (10, figs. 1 and 4; fig. 5 is not typical *arenosa*). If *nesiotis* had enlarged central tubercles on the actinal plates it would be classified under *schmideliana*. *Nesiotis* has an entirely different abactinal surface from that of *novaeguineae* (fig. 3). If it is an off-shoot of *plana* it furnishes a reason for regarding *plana* as specifically distinct.

Family LINCKIIDAE

Ferdina cancellata tylota subsp. nov. (See Plate V, *A*.)

Diagnosis. R=16.5 mm., r=5.5 mm. R=3r. Breadth of ray at base, 6 mm. Rays convex abactinally, evenly tapered to a blunt extremity. Differing from *F. cancellata* (Grube) in having the transverse series of abactinal convex plates much less regular and less well defined; a relatively more prominent median radial series of plates and no transverse serial arrangement whatever of the papular pores.

Description. In the center of disk is a convex plate and along the radial line of the ray, seven or eight similar, convex bare plates, usually contiguous. The primary radial is separated from the aforesaid central by two smaller granulated plates, and near the end of the radial series there are a few small, granular plates, with sometimes one or two interpolated irregularly along the series. There are six larger, convex, bare superomarginals, alternating with much smaller granulated plates of unequal size, squeezed somewhat out of alignment. A few of the minor superomarginals have a bare center and the two distal majors are in direct contact. There are four irregular transverse series of more convex abactinal plates, of which a large radial is the center, a smaller superomarginal the outer end, and between these, one or two convex, dorsolateral plates generally with a bare center. The other dorsolateral plates are flattish, in proximally two, distally one, irregular series between the radials and superomarginals. They are finely granulated, the granules overflowing the edges of the bare plates and ending abruptly. The granules are 0.045 to 0.05 mm. in diameter, those immediately surrounding the papular pores being largest. Papular pores solitary, entirely abactinal.

Inferomarginals eleven to thirteen, of which about seven are more or less bare and convex, especially at end of ray. The last one or two have a small tubercle. Proximally the series is rather irregular and ill-defined. The terminal plate is broadly cordiform, not so broad as the penultimate superomarginal but broader than the median radial plates. Actinal plates in two series, granulated, the inner extending to last inferomarginal, the outer series for two-thirds length of the ray. Some of the actinals of distal half of ray have a small central tubercle.

Adambulacral plates squarish; spines two, a little longer than plate, round-tipped or truncate, the adoral usually the longer of the two and broader at tip. The surface of the plate is covered with a fine granulation uniform with that of the actinal plates, and this extends on outer side nearly to the tips of the spines which are thus united by a continuous membrane. Mouth spines four or five (the apical a little the largest) similar to the adambulacral spines.

Madreporic plate slightly convex, 1.25 mm. in diameter, midway between anus and margin. Anus surrounded by four unequal large granules.

Color, dried, pale yellowish buff; bare spaces of plates bister brown; depressions along borders of abactinal plates shaded with cinnamon, the central part of the granulated plates being light buff.

Type. Bishop Museum collections. Type locality, Wake Island.

Remarks. Clark (1) has prepared a very useful key to the species of Ferdina. The present race resembles both *cancellata* and *ocellata*. The type-locality of *cancellata* is unknown, although a specimen from the Fiji Islands is recorded by Lütken. The type of *ocellata* was taken at Murray Islands, Torres Strait. The Wake Island form could, with equal propriety, be regarded as a race of *ocellata*. I think that the three are forms of a single species characterized by transverse rows of convex abactinal plates and irregularly alternating larger and smaller superomarginal plates. The small tubercles on the distal actinal plates may prove to be an added characteristic of *tylota*.

That portion of Clark's key (1, p. 58) in which *tylota* belongs may be emended as follows:

Superomarginal plates in irregularly alternating series of large and small plates; certain abactinal plates, more convex than the rest, form more or less well defined transverse series, corresponding in position to smaller superomarginal plates.

a^1. Interradial pair of superomarginals not conspicuously larger than the second (major) plate; at least some of the plates involved in the transverse series, naked.

b^1. Transverse rows of plates quite regular, naked; large carinal plates between series not apparent; papulae in more or less evident transverse rows.
cancellata Grube.

b^2. Transverse rows of plates not very regular; not all naked; a large naked carinal plate between the transverse rows; carinals as a series, conspicuous; papulae irregular, not at all in transverse rows.
tylota Fisher.

a^2. Interradial pair of superomarginal plates rather conspicuously enlarged; only two to four naked tubercle-like plates on middle and distal part of ray; proximal carinals granulated and not especially conspicuous; plates of poorly defined transverse series, finely granulated.
ocellata Clark.

Ophidiaster lorioli Fisher.

Ophidiaster lorioli Fisher (4), 1906, p. 1077, pl. 31, figs. 4, 4a-4d; pl. 39, fig. 3. Clark, 1921, p. 84.

The Bishop Museum collections include one specimen from Wake Island and one from Samoa.

Both specimens are typical although that from Wake with unequal rays and R 22 mm. has very few of the characteristic excavate "sugar tongs" pedicellariae. The Samoan example, with R 27.5 mm., has rather numerous pedicellariae and three or four papular pores in the abactinal areas and two or three in the intermarginal and actinal areas.

Both specimens, dried, are pale dull buff with bleached out pinkish patches.

Dactylosaster cylindricus pacificus subsp. nov. (See Pl. VIII, *b*.)

Diagnosis. Differing from *D. cylindricus* of the Indian Ocean in lacking pedicellariae. R=66 mm., r=8.5 mm., R=7.7r; breadth of ray at base, 10 mm.

Remarks. The old *Ophidiaster cylindricus* of Lamarck, for which Clark has resuscitated Gray's Dactylosaster, has been well described and figured by de Loriol (1885, p. 20, pl. 11, figs. 3, 4). No differences have been recognized in the Hawaiian form, other than the constant absence of pedicellariae, already recorded by Clark (1, p. 85).

The type of *pacificus* has seven to fifteen papular pores in the adradial series of areas; about the same number adjacent to the superomarginal plates; seven to ten in the intermarginal and inframargnal series. The median radial (carinal) series of plates carry 15 to 20 of the scale-like granules proximally and eight to fifteen distally. Those in the center, or on the distal margin of the group (which is often crescentic) are the largest. In smaller specimens there may be as few as three or four large and several small. The number is variable. The surface of the plates is covered with small, somewhat hyaline bosses beneath the skin similar to those found on the superomarginals of some Asteriidae (e. g., Sclerasterias, Astrometis). Beyond the base of the ray are two actinal plates, which correspond to each inferomarginal with considerable regularity. At the base of one ray a second short series is wedged between the regular series and the inferomarginals. In a specimen from Ocean Island having R 50 mm. this series reaches the middle of ray. The adoral of the two furrow species is slightly the slenderer. In the type, the slenderer spine has a somewhat expanded subspatulate tip. The ovate granule between the spines varies slightly in its proximity to the tip. The spines are immersed in a common web or membrane which, on the outer side, is more or less beset at the base with small spaced granules uniform with those of the actinal surface of the plate. In one case (Ocean Island) these granules extend the full length of the spines. There is considerable variation in the shape of the subambulacral spine of alternate plates. It is subcylindrical, ovoid, blunt, slender to stout, straight to curved.

Type. Bishop Museum, Laysan, May 19, 1923.

In addition to the type specimen the Bishop Museum collections include three specimens from Ocean Island and one from a doubtful locality.

Linckia multifora (Lamarck)

Johnston Island, seven specimens.

Wake Island, twelve specimens.

Palmyra Island, one specimen.

The largest specimen, from Johnston Island, has R 81 mm. and the ray is 6.6 times as long as width at base; madreporites, two. Two specimens from Johnston are comet forms. One specimen from Johnston and one from Wake have six rays; the former has three madreporites, but the latter, only one.

Clark (1, p. 64) has indicated the difficulty in distinguishing some specimens of *laevigata* from *multifora*, especially when small. Ordinarily *L. multifora* can be distinguished at once from *L. guildingii* by the absence in the latter of the vertical row of granules between the adambulacral spines. Unfortunately in very small *multifora* these granules are lacking, as Clark

has reported for *laevigata*. No adult *guildingii* were taken at Johnston or Wake so that the problematical small specimens have been referred to *multifora*.

Linckia laevigata (Linnaeus)

Agaña, Guam, collected by Alvin Seale, two specimens.

These are the typical form, with abactinal papular areas larger than the adjacent plates.

I received a specimen from Hong Kong in 1922, collected by Prof. A. S. Campbell, then of the Canton Christian College.

Linckia guildingii Gray

One specimen, Laysan Island.

Genus LEIASTER Peters

The new form described below can best be understood by the following synopsis which is adapted from that of Clark (1, p. 72). Since the genus can be equally well subdivided on the basis of the presence or absence of a definite well-defined groove on the inner surface of the furrow spinules, or on the presence or absence of minute bosses on the center of the primary plates, the latter has been chosen by way of variety, Clark having used the former method.

a^1. Plates smooth, without a central area of minute, more or less hyaline bosses (usually spoken of as granules).

b^1. Furrow spines three or four to a plate with a definite longitudinal groove on inner face.

c^1. R about 6 br; no pedicellariae; abactinal papulae not in well defined areas. **coriaceus** Peters.

c^2 R about 8-9 br; pedicellariae numerous; abactinal papulae in definitely circumscribed areas. **analogus** Fisher.

b^2. Furrow spines not grooved on the inner surface (or only very faintly so on basal half); furrow spines three to a plate; no pedicellariae.

c^1. Rays slender, tapering; middle furrow spine usually longest; skin soft and thin; color in life unknown. **teres** Verrill.

c^2. Rays short, stout, not tapering; furrow spines equal; skin thick, tough, smooth; color in life deep maroon purple; tube-feet deep yellow. **callipeplus** Fisher.

a^2. Plates with a defined area of minute bosses which under the dried skin have the appearance of granules; border of plate smooth; furrow spines without a definite longitudinal groove.

b^1. Furrow spines three to a plate (occasionally two) the base line of the comb of three shorter than length of spines; base line of comb of two is 0.4 length of spines; a few pedicellariae present; R about 9 br. **hawaiiensis** Fisher.

b^2. Furrow spines two to a plate, rarely three on individual plates.

c^1. Furrow spines long and slender, the length twice the width of a pair, or more; color in life, or dry, red, more or less bright crimson; in very large specimens sometimes nearly black, when dry.

d^1. R about 10-11 br; usually no pedicellariae. . **leachii Gray.**

d^2. R about 7-8 br; pedicellariae present. **speciosus Von Martens.**

c^2. Furrow spines short and wide, the length about equal to width of a pair, or a little more; color (dry) dull purplish-gray (probably purple in life). **brevispinus Clark.**

Leiaster leachii hawaiiensis subsp. nov. (See Pl. VIII, *a*; fig. 9, *i*.)

Diagnosis. Differing from *L. leachii* Gray, of the western part of the Indian Ocean, in having usually three furrow spines (some of which show the faintest trace of a longitudinal depression), heavier, spatulate, subtruncate subambulacral spines, and a few abactinal pedicellariae. R 108 (longest ray); r 10 mm.; br. 12 mm. R=10.8r or 9 br.

Description. Rays slender, depressed by drying. Plates as usual on Leiaster. A subcircular central area surrounded by a narrow, smooth border is covered with small subhyaline bosses, exactly similar to those found on the superomarginal plates of certain Asteriidae (e. g., Sclerasterias, Astrometis). They are covered by the skin and in life are undoubtedly invisible. Papular areas separated and distinct, largest on mesial third of ray and decreasing in size regularly proximally and distally. Largest areas with 10-15 pores. A very few small, entrenched abactinal pedicellariae resemble those of *L. analogus,* the whole apparatus being slightly curved and 0.58 mm. long.

Furrow spinelets in crowded combs of three, or occasionally two, their tips forming a bluntly serrate border to the continuous membrane which unites them from mouth angle to tip of ray. The spinelets are subequal, flat-faced (with sometimes a faint indication of a longitudinal depression), scarcely tapered, except toward the blunt or round-tipped, roughened extremity. The spines are about 1.2 mm. long and the width of a comb of two is 0.4 the length, and of three, 0.6 the length of the spines. They are thus much longer relatively than in *L. brevispinus* Clark. The first 10-20 plates each have a subcylindrical, slightly flattened, round-tipped or subtruncate subambulacral spine. This series is united with that of the adjacent ray by a continuous web across the mouth angle. Suboral spines (of this series) not enlarged. Beyond these, distally, usually only alternate plates carry a spine which is much heavier. It becomes wider, more flattened, and sometimes shallowly gouge-shaped.

Madreporite prominent, 2 mm. in diameter. Color of dried specimen, yellow ochre, more brownish on papular areas.

Type-locality, Koloa, Kauai. A single specimen was collected in 1900.

Remarks. This species is easily separated from *callipeplus* by its rough plates and longer rays, and from *coriaceus* and *analogus* by the absence of a well-defined groove on the furrow spines. It belongs to the *leachii* group. True *leachii* lacks pedicellariae, of which there are a few on *hawaiiensis;* and it has only two furrow spines to each plate, the combs being slightly spaced, not crowded. *L. speciosus,* which I think is a race of *leachii* has only two furrow spines and a variable number of pedicellariae. It has stouter rays than *hawaiiensis.* Clark's *brevispinus* from the Hawaiian islands has very short furrow spinelets, usually two in number, the length

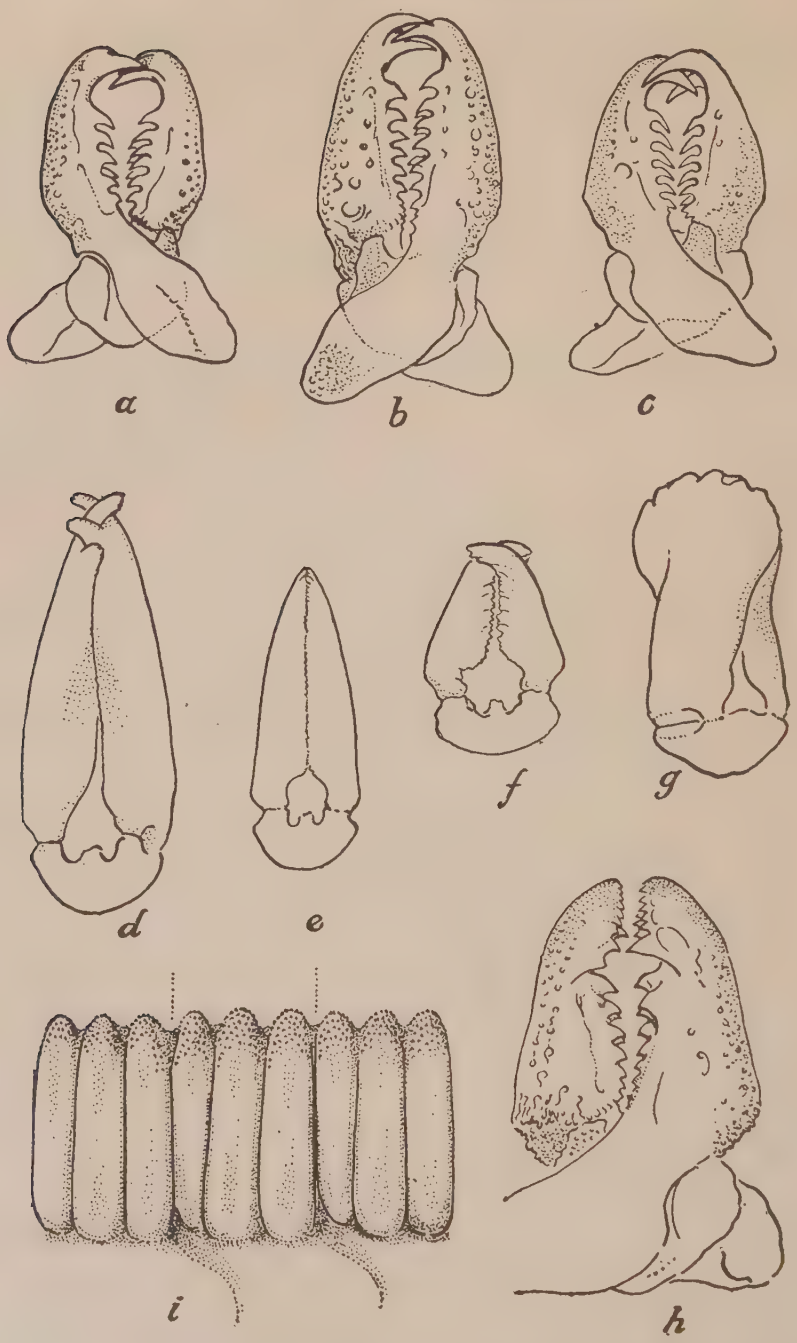

FIGURE 9. Illustrations of pedicellariae: *a, Coronaster eclipes,* crossed pedicellaria 0.4 mm. long X 100; *b, Coronaster halicepus,* a crossed pedicellaria for comparison,

equal to a little more than the width. On the two-spined plates of *hawaiiensis* the width is .4 of the length, and on three-spined plates, .6 of the length of the spines.

L. teres is scarcely known.

Family ASTERINIDAE

Asterina cepheus (Müller and Troschel).

Wake Island, four specimens, Tanager Expedition.

The largest specimen has R 17 mm., r 8.5 mm. In three specimens the rays taper little and have a broad, rounded end. The fourth specimen (R 12 mm.) is more conventionally stellate, about as in de Loriol's figure (9, pl. 21, fig. 3).

The furrow combs have four rather long, tapered, bluntly pointed spinelets, the laterals about 20 per cent shorter and a little slenderer than the two centrals. Subambulacral spinelets three or two, a little shorter than the furrow spinelets and a little longer than the adjacent actinal spinelets, of which there or two or three, rarely four, to a plate over the actinal area. Mouth spines eight to ten to an angle, increasing rapidly in stoutness from the laterals to the centrals which are also the longest. The larger abactinal plates carry along the curved margin adjacent to the papulae 20 to 35 delicate, sharp spinelets in two or three tiers. There are only eight rows of papular pores. The spinelets surrounding the madreporite are not different from the rest.

Clark (1, p. 26) says: "The abandoning of Gray's name (*burtonii*) for this sea star is quite unjustifiable even though the type specimen is lost, for in my judgment the original diagnosis is unmistakable when considered in connection with the locality given."

Gray's account of *Asterina burtonii* is as follows: "Rays elongate, convex, blunt at the end, each of the ossicula of the oral surface with a central group of three crowded, mobile, tapering spines, of the dorsal surface with a crowded group of short tubercles. Inhab. Red Sea." It is curious that Gray should particularize concerning the actinal "mobile, tapering, spines" and describe the still more delicate, sharp spinelets of the dorsal surface, "short tubercles."

I think we have a case similar to that of *Othilia purpurea* and *O. luzonica*. The *A. cepheus* of authors is probably not a single species, but

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0.5 mm. X 100; *c, Coronaster volsellatus,* a crossed pedicellaria, 0.42 mm. X 100; *d, e, Coronaster volsellatus,* two straight pedicellariae from the furrow, *d,* 1.1 mm. long X 50, *e,* 0.4 mm. long X 100; *f, Coronaster eclipes,* characteristic straight pedicellaria from furrow, 0.27 mm. long X 100; *g, Coscinasterias acutispina,* Pearl and Hermes Reef, a broad straight pedicellaria X 50; *h, Coscinasterias acutispina,* Ocean Island, a crossed pedicellaria, 0.27 mm. long X 200; *i, Leiaster leachii hawaiiensis,* furrow face of adambulacral spines, proximal third of ray (3 plates), X 25.

several. I venture the prediction that, when adequate material can be assembled and compared by one person, the west Indian Ocean and Red Sea form will be found to be separable from true *cepheus* (type-locality, Batavia); while not improbably along the eastern frontier of its range, in the Pacific, another race will be recognized. The specimens from Wake Island will fall in this group.

Whatever the fate of Gray's name, *burtonii* (and I feel that in the absence of a type-specimen it is of very doubftul value), *cepheus* is more applicable to the Pacific form of the species.

Asterina coronata cristata Fisher.

Asterina cristata Fisher, Biol. Soc. Wash. Proc., vol. 29, 1916, p. 27.
Asterina coronata cristata Fisher Ann. and Mag. Nat. Hist., ser. 9, vol. 2, 1918, p. 111.—1919, p. 411, pl. 115, fig. 3; pl. 131, figs. 4, 4a.

Palmyra Island, two specimens.

One specimen has six symmetrical rays, R 8 mm.; the other is also six-rayed, but one-half the body is regenerating, R 8 mm. The three new rays appear to be replacing two lost ones.

For an account of this species and apparent races see Fisher (5, pp. 411-416). The Palmyra specimens are too young to identify with certainty, but are nearest to *cristata* which heretofore was known only from the Caroline Islands. The prominent plates are not yet conspicuous and might easily be overlooked. There are only one or two on each ray, starting to develop the characteristic disparity in size. There are two or three actinal intermediate spinelets in a comb, five or six furrow, and three or four subambulacral spines. The marginal mouth spines number seven (or fourteen to a mouth angle, the median flattened, blunt, and much heavier than the laterals). In this character the Palmyra specimens, although still very small, exceed the number of mouth spines of *cristata* which is usually five (10 to an angle), and approach that of *cuerces* (Palawan) in which there are eight or nine marginal mouth spines. If six rays predominate in the Palmyra form this will constitute another variation of importance, since all the races of *coronata* are five-rayed.

Family ECHINASTERIDAE

Othilia luzonica Gray.

Palmyra Island, seven specimens.

I am following Clark (1, p. 98) in using Gray's name *luzonica* for the East Indian and Pacific representative of *O. purpurea,* of the western Indian Ocean and Red Sea. It has been figured and described by Fisher (5, p. 432, pl. 122, fig. 1, pl. 132, figs. 7, 7a-b, as *purpurea*) and Clark

(1, p. 98, pl. 10, figs. 2-4, color). Clark has observed the species alive at Torres Strait. As he states, *purpurea, vestita,* and *fallax* are one species while *luzonica* and *eridanella* refer to its eastern representative, found from Ceylon and the Philippines to northeastern Australia, Torres Strait, New Britain and New Caledonia. The discovery of *luzonica* at Palmyra extends its range nearly to the Hawaiian islands, where the species has never been recorded.

Although I have used the binomial form to avoid undue confusion, I think that *luzonica* will prove to be a geographical race of *purpurea.* More properly speaking, I think the latter is an offshoot of *luzonica.* Clark has given a useful synopsis of the distinctive characters. The difference in proportions is found in large specimens only. Small *luzonica* may have the radii only three to five r, judging by the Palmyra material.

The largest specimen has R 46 mm., r 9 mm. Four have five rays and three have six rays. Three five-rayed examples and one six-rayed have two madreporites, while in the others I can not be sure of more than one. There are holothurian-like deposits in the skin (5, pl. 132, figs. 7, 7a-7b) especially around the papular pores. There are two comet specimens, for this species propagates by autotomy and subsequent regeneration of four or five rays (5, p. 434; 1, p. 99). Both of the Palmyra specimens have five new rays.

Family ACANTHASTERIDAE

Acanthaster planci (Linn.).

Asterias planci Linnaeus, Syst. Nat., ed. 10, Appendix, 1758, p. 823. Synonymy, Fisher 1919, p. 441.

Johnston Island, two specimens.

Pearl and Hermes Reef, Southwestern Island, one specimen.

Clark has already recorded (1, p. 101) this species from the Hawaiian islands. It is, as he states, a remarkable animal. It is so unlike any of its apparent relatives that we must regard it, I think, as a hold-over from a very ancient fauna—a sort of surviving fossil. I submit this as justification for placing it in a distinct family.

The larger of the two specimens from Johnston Island has R 148 mm., 16 rays and 8 madreporites. The other has R 98 mm., 15 rays and six madreporites (five consecutive interradii without any). There are three furrow spines, the central the longest, and at either end of this fan, a rudimentary spinelet. Below the adoral spinelet there is usually a very small, slender pedicellaria. The longer abactinal spines of the disk are 15 to 19 mm. long; those of ray, about 20 mm. (including the pedicel arising from plate).

The specimen from Pearl and Hermes Reef is young (R 27 mm.), has 14 rays, and eight madreporites. The distal half of the spines is colored dull magenta, paler at base. The abactinal spines are terete, tapered, with a sharp pointed, three-edged tip. This is prominent in the young, but inconspicuous in the large specimens from Johnston Island. Slender abactinal pedicellariae are abundant in all three examples, and are fairly numerous actinally in the two large specimens.

Family MITHRODIIDAE

Mithrodia bradleyi Verrill.

Mithrodia bradleyi Verrill, Conn. Acad. Trans., vol. 1, 1869, p. 288. Fisher, 1906, p. 1094, pl. 36, figs. 1 and 2; pl. 37, figs. 1 to 3).

Laysan Island, one specimen; French Frigate Shoals, one specimen; Johnston Island, one specimen.

The three examples of this archaic and bizarre species are all referable to the Hawaiian form of *bradleyi,* of which a description and photographic figures are given in my paper on Hawaiian starfishes (4).

The pedicellariae, however, were not noted; they may have been invisible in alcoholic specimens. These occur between the subambulacral and the actinal spines (or very rarely on the lateral surface of ray) on slight, scaly prominences and consist of four very slender, terminally incurved spinelets surrounding a tiny pit. When open, the jaws radiate apart at right angles. Sometimes the jaws are only slightly curved at the tip; or they may form nearly a semicircle; often the four jaws are irregularly twisted about one another at the end. In the Laysan specimen having R 225 mm. the straighter jaws are 0.5 mm. long. In the other two specimens the pedicellariae are few.

An example of typical *bradleyi* from Lower California has a few of these pedicellariae, which may be characteristic of the species since they have not been reported in *clavigera.*

Family ASTERIIDAE

Genus COSCINASTERIAS Verrill

Subgenus STOLASTERIAS Sladen

Coscinasterias acutispina Stimpson. (See fig. 9, *g, h.*)

Ocean Island, one specimen, eight rays; Pearl and Hermes Reef, one specimen, seven rays.

This species which is related to *C. tenuispina* of the Atlantic has heretofore been recorded only from Japanese waters. Its occurrence in the

Hawaiian group, rather than that of *C. calamaria*, is of great interest and indicates the presence of a Japanese element in the fauna which I have already noted.

C. acutispina is likely to be confused with *calamaria*. In *calamaria* alternate plates of the carinal (or midradial) series are different. The spiniferous plates have lateral lobes while the alternate spineless plates are oblong, or oblong-elliptical without lateral lobes. In *acutispina* all the plates are alike and have lateral lobes, although in small specimens these lobes are not conspicuously developed.

I have compared the Hawaiian examples with a specimen from Yeddo Bay, Japan. Except for the presence of three or four madreporites, none of the four examples shows signs of the fissiparity so characteristic of *C. tenuispina*. I think it may be confined to small examples, as is apparently the case in *calamaria*. In Sclerasterias fissiparity is characteristic of a definite postlarval stage in at least four species. In *acutispina* the carinal, dorsolateral, and superomarginal spines form five fairly straight longiseries, the carinal spines closer together than the others. In *tenuispina* the dorsolateral series is zigzag or irregular, and frequently also the carinal series is somewhat irregular at base of ray.

In the better preserved specimen from Ocean Island only a few rudimentary actinal spines have appeared. In the Yeddo Bay specimen they extend for half the length of the ray, or slightly more. Spatulate, dentate, straight, pedunculate, pedicellariae are characteristic of this species, and in the Hawaiian specimens are found along the furrow margin and scattered over the abactinal surface. One, 0.8 mm. long, is illustrated (fig. 9, *g*). The crossed pedicellariae (about 0.27 mm. long) have a characteristically enlarged tooth on the outside of the terminal lip of each jaw, but not on the inside (fig. 9, *h*). Crossed pedicellariae are absent from the inner inferomarginal spine and actinal spines.

It is not unlikely that *C. calamaria* will be found in the Hawaiian islands, as possibly also some species of Distolasterias. Since the identification of the genera of Asteriidae is difficult, a key to the genera of Coscinasteriinae may prove useful. *Coscinasterias* (*Distolasterias*) *euplecta* dredged by the Albatross Expedition belongs to Sclerasterias.

KEY TO THE GENERA OF COSCINASTERIINAE

The carinal (or median radial), the conspicuous marginal, and the actinal plates (when present) form regular longiseries; carinals, dorsolaterals (sometimes also in regular longiseries), and superomarginals carry a single stout or slender, smooth or fluted, sharp or blunt, prominent, spike-like spine (sporadically two or three), provided with a collar of crossed pedicel-

lariae; inferomarginals regularly with two prominent spines (sporadically three); actinal plates never in more than one series, sometimes lacking; furrow spines one or two, always without attached pedicellariae, but these may occur on oral spines; gonads open dorsally.

Coscinasteriinae.

a^1. Only the outer of the two inferomarginal spines carries a cluster of crossed pedicellariae.

b^1. Adambulacral plates with two spines, at least on proximal half of ray; as a rule only two, or equivalent of two, series of dorsolateral papular areas (by no means always regular) on either side of carinal plates (alternate superomarginals usually spineless).

c^1. Rays regularly only 5 in adults, but six in fissiparous young of some forms.

d^1. Large spatulate, denticulate, straight pedicellariae; outer inferomarginal spines without trace of a ventrolateral web; rays semicircular or heptagonal in section; dorsal skeleton very irregular, the skeletal meshes not in two regular series on either side of the carinal ridge; dorsolateral spines developed in even tiny specimens; they are numerous, in one or two irregular series on each side; adambulacral plates diplacanthid proximally, monacanthid distally. Type, *Asterias sertulifera* Xantus.

Astrometis Fisher (6).

d^2. Straight pedicellariae slender, lanceolate; outer inferomarginal spines connected in longiseries by a continuous more or less fibrous web confined to base of spines much retracted in some dried specimens; rays pentagonal in section; dorsolateral skeleton regular, with two series of skeletal meshes on either side of the prominent carinal ridge; dorsolateral spines usually late in developing and in only one series; adambulacral plates with two spines throughout; the very young are fissiparous, usually six-rayed, possibly reproducing regularly by fission. Type, *Sclerasterias guernei* Perrier.

Sclerasterias Perrier.

c^2. Rays 7 to 9; so far as known not fissiparous; in general appearance similar to Sclerasterias but ray less markedly hexagonal in section; a well-developed series of dorsolateral and actinal spines; inferomarginal web absent or very rudimentary; only alternate superomarginals spiniferous, the plates generally with a conspicuous beaded area (present also in Sclerasterias and Astrometis); mouth angle rather narrow, with three to five contiguous pairs of postoral adambulacral plates; straight pedicellariae medium to large, smooth or denticulate. Type, *Margaraster scaber* Hutton.

Astrostole Fisher (6).

b^2. Adambulacral plates monacanthid throughout ray.

c^1. One series of spiniferous actinal plates.

d^1. Fissiparous, rays seven to twelve; skin covering skeleton not unusually thick and tough. (Crossed pedicellariae larger, more tapered in profile; large straight pedicellariae with denticulate jaws.) Type, *C. muricata* Verrill.

Coscinasterias Verrill.

d^2. Not fissiparous, rays five to seven; skeleton obscured by a thick tough skin; crossed pedicellariae very small, round tipped, not conspicuously tapered. One series of spiniferous actinal plates; dorsolateral skeleton irregularly reticulated, the papular areas equivalent to three or four longiseries, but only the lateralmost in a regular series; abundant, large, broadly lanceolate, straight pedicellariae, with rather compressed denticulate jaws. Type, *Asterias gelatinosa* Meyen.

Meyenaster Verrill.

c^2. One series of small, spineless actinal plates hidden by skin. Not fissiparous; rays five; dorsolateral skeleton normally fairly regular, the papular areas in two longiseries on either side of the carinal series; dorsolateral and carinal spines either regular or very irregular (*africana*). Type, *Marthasterias foliacea* Jullien=*Asterias glacialis* Linn.

Marthasterias Jullien.

a^2. The inner as well as the outer inferomarginal spine carries a cluster of crossed pedicellariae; adambulacral plates with two spines.

b^2. Secondary oblong ossicles between consecutive plates of both carinal and superomarginal series; crossed pedicellariae unusually large. All primary plates spiniferous; one or two series of four- or five-lobed dorsolateral plates in quincunx and connected by one or more slender ossicles, forming a very open-meshed skeleton with large, triangular, and lozenge-shaped papular areas; crossed pedicellariae characteristically large, with clawed tips; a few relatively huge, unguiculate, straight pedicellariae; actinal plates rudimentary, spineless; adambulacral spines 2, mouth angle stout, with two pairs of contiguous postoral adambulacral plates; not fissiparous. Type, *A. forreri* de Loriol.

Stylasterias Verrill.

b^2. Carinals and superomarginals directly imbricated in series, without interpolated secondary oblong ossicles; three (or the equivalent of three) or more dorsolateral series (often very irregular) of papular areas on either side of the carinal plates.

c^1. A definite series of well-developed actinal spines, each with a conspicuous cluster of crossed pedicellariae on its outer side; crossed pedicellariae without two terminal teeth larger than the other teeth; straight pedicellariae large, broadly lanceolate, compressed, to spatulate denticulate or unguiculate; oral carina narrow, with upward of five contiguous pairs of postoral adambulacral plates; actinostome sunken. Type *A. koehleri* de Loriol (*O. columbiana* Ver.).

Orthasterias Verrill.

c^2. Actinal spines absent, or, if present, are devoid of attached pedicellariae; adoral carina not especially long or narrow, nor actinostome sunken (two or three pairs of contiguous postoral adambulacral plates).

d^1. A definite series of spineless actinal plates hidden under a thick integument; each carinal and superomarginal plate regularly spiniferous.

e^1. Crossed pedicellariae with two enlarged terminal teeth on each jaw, conspicuously larger than the median terminal teeth; dorsolateral plates not exceptionally numerous, in two or three regular or irregular series on each side; some species with large unguiculate straight pedicellariae. Type, *A.* (*Stolasterias*) *stichantha* Sladen.

Distolasterias Perrier.

e^2. Crossed pedicellariae without enlarged terminal teeth; predominant straight pedicellariae relatively very large, broadly spatulate, with long, curved tines (resembling a pair of clasped hands); dorsolateral plates very numerous, small, crowded, irregularly arranged, but in the equivalent of four to six (or more) series on each side; (spines ornately fluted). Type *A. nanimensis* Verrill.

Lethasterias Fisher (6).

d^2. A conspicuous series of actinal spines (without a cluster of attached crossed pedicellariae); crossed pedicellariae very small, without any of the terminal teeth enlarged; all straight pedicellariae slender, lanceolate; two pairs of contiguous postoral adambulacral plates, each carinal and superomarginal not regularly spiniferous, usually only the alternate plates;

dorsolateral spines few, scattered. Type, *Coscinasterias dubia* Clark (Tasmania).

Australiaster Fisher (6).

Coronaster eclipes sp. nov. (See fig. 9, *a-f.*)

Diagnosis. Differing from *C. volsellatus* in having two adambulacral spines, and smaller and broader straight pedicellariae on furrow face of adambulacral plates. Differing from both *C. volsellatus* and *C. halicepus* in lacking the characteristic large unguiculate hand-shaped pedicillariae, as well as the small lanceolate dermal straight pedicellariae (except on furrow face of the adambulacral plates). Number of rays unknown.

Description. This species is founded upon a single ray, having certain very definite characters which distinguish the species from the two known Pacific forms of Coronaster. A resumé of what is known of Coronaster is given in Fisher (5, p. 494). Since *eclipes* has two furrow spines, the natural assumption would be that it is more closely related to *halicepus,* which has two. But the crossed pedicellariae, a surer indication of kinship, are more nearly like those of *volsellatus,* both as to size and form; while the very small straight pedicellariae of the furrow margin, with strongly hooked jaws, somewhat resemble the much bigger and narrower pedicellariae of *halicepus.*

The general appearance of different species of Coronaster is much alike. The ray of *eclipes* is not different in structure from that of *volsellatus* or *halicepus* (10, pl. 107; 5, pl. 140). There are five longiseries of sharp, acicular spines representing the carinal and marginal series, and at base of ray, indications of one or two dorsolateral spinules. The proximal carinal spines are 3.5 mm. long; the inferomarginals, 4.5 mm. The skeleton consists of the usual squarish meshes, near the center of which are a few papulae. The abundant lanceolate dermal straight pedicellariae of both *volsellatus* and *halicepus* are absent. The spines are sheathed and abundantly supplied with crossed pedicellariae. This sheath is capable of forming a shallow web between the bases of the inferomarginal spines. The spine pedicellariae are about 0.4 mm. long and are very similar to those of *volsellatus,* but quite distinct from those of *halicepus,* as shown in the accompanying profile views. The pedicellariae of *halicepus* are 0.5 to 0.58 mm. long and have more numerous shank teeth. Each jaw in all three species has two terminal teeth[9] between which is a transverse row of small teeth. A view of the distal end of a pedicellaria resembles a microscopic carnivore's skull.

The furrow spines form an oblique series, the outer adorad, and proximally 2.25 mm. long, while the inner is about two-thirds as long. Both are very slender, slightly tapered, blunt. The furrow face of each plate carries one or two small pedunculate straight pedicellariae, 0.27 mm. long. In *volsellatus* these pedicellariae are lanceolate and very unequal in size. Many are as long as 1.1 to 1.2 mm., while the smallest are seldom less than 0.4 mm. The form is shown for comparison in fig. 9, *d-f,* of these figures *e* and *f* are enlarged 100 times and fig. *d* only fifty times. In *volsellatus* and to a somewhat less extent in *halicepus,* there are similar small dermal pedicellariae on the actinal surface of the adambulacral and inferomarginal plates, a continuation of the supply with which the skin is peppered; but in *eclipes* these are lacking. The tube-feet are proximally four-ranked (or in two sharply zigzag rows); distally they become two-ranked as the furrow narrows. Mouth plates unknown.

Type. No. E 1197, U. S. National Museum.

[9] Not three, as stated by me (5, p. 497). This was an abnormal pedicellaria.

Type-locality. Albatross station 4031, Penguin Bank, off south coast Oahu, 27 fathoms, coral, fine coral sand and foraminifera.

Remarks. The type came to light after my publication (4). The ray was lasooed with hempen tangles from the very rough bottom of Penguin Bank, a locality which yielded two other new species—*Astropecten hawaiiensis* and *Luidia hystrix*. In moderate depths there are undoubtedly numerous rare species to be garnered by the same method.

C. eclipes is another species whose nearest relatives live in the Eastern Archipelago. No species of Coronaster has been found along the Pacific Coast of America, although there are three or four nominal forms in the Atlantic.

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ECHINODERMS OTHER THAN SEA STARS

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INTRODUCTION

Until the visit of the "Albatross" to the Hawaiian islands in 1902, knowledge of the echinoderm fauna of the group was very slight, based chiefly on the collections made by A. Garrett in the "fifties" and the brief visit of the "Challenger" some twenty years later. The work of the "Albatross" revealed a rich and interesting echinoderm fauna with many endemic species, closely allied to that of the great Indo-Pacific area. The distant isolated islands to the south and west of Hawaii were not touched at that time and until now very little knowledge has been had of their marine fauna, an essential to the proper interpretation of that of Hawaii. The work of the Tanager Expedition has therefore been pioneer work of great importance and in spite of the brevity of the visits made to these interesting islands, has thrown light on the origin of the Hawaiian marine fauna.

It gives me pleasure to express here my sincere thanks to the authorities of the Bishop Museum and particularly to Dr. Stanley C. Ball, for the honor conferred in asking me to prepare this report and for the pleasure I have derived from the study of this interesting material.

TAXONOMY

OPHIUROIDEA

(Brittle-stars. Serpent-stars)

The brittle-stars collected by the Tanager Expedition, which were sent to me for determination, number 175. Most of them are well preserved, but some are in poor condition, and many are very young. They represent not less than fourteen species and one well marked variety, but there are at least two species whose identification cannot be made. One of these was taken in 200 fms. near Laysan; only arm fragments were preserved and these are obviously an amphiurid with excessively long arms. The other species is also an amphiurid but is a short-armed Amphiodia, probably; the specimens are too young for certain generic determination. The smallest, with disk less than a millimeter in diameter, has no tentacle-scale and four arm spines; the others, which are only a trifle larger, have one tentacle-scale and five arm spines. It is therefore possible that two species are represented, but I think it more likely that simply growth stages of a single species are involved. All the specimens are from Oahu; of these one is from Waikiki Beach.

Ophiologimus quadrispinus [10] sp. nov. Plate IX, *A, B.*

Disk 8 mm. in diameter; arms five, about 36 mm. long. Disk covered by a close coat of fine scales, more or less concealed by a skin, which when moist looks as though it bore a dense coat of very minute granules; on drying, this granular appearance disappears and the fine scaling of the disk becomes visible. Radial shields narrow, parallel bars, about 1½ mm. long and ¾ mm. apart, completely concealed under the disk covering; their form and position are evident only in the dried specimen. Base of arms covered like disk. Upper arm plates very well developed, slightly overlapping, pentagonal with distal angle rounded, as wide as long or wider. Interbrachial spaces below covered like disk. Genital slits long and conspicuous, the abradial margin fringed with numerous, small, acicular spinelets.

Oral shields somewhat pentagonal, with rounded corners, more or less concealed by skin, considerably wider than long. Adoral plates large and meeting broadly within but the skin conceals their outlines. They certainly separate the oral shield from the first under arm plate; oral plates small and indistinct but noticeably swollen or elevated above the jaw surface. Oral papillae about seven on each side, of which the two outermost are largest and bluntest; the innermost, just below the teeth, is relatively large but pointed; the remaining four are small and pointed. Teeth small, pointed, only three or four in each column. No tooth papillae.

First under arm plate small, longer than wide, the lateral margins strongly concave, the ends a little convex; second plate fully twice as large, and relatively much wider as its width about equals its length; succeeding plates becoming distinctly longer than wide, the lateral margins concave and the distal end broadly rounded; under arm plates broadly in contact and perhaps a little inclined to overlap. Side arm plates well developed but not meeting either above or below, until near the tip of the arm; each plate carries a vertical series of four long, flat, bluntly pointed, sub-equal arm spines which are longer than the joint; they seem not to be hollow. Tentacle pores large, each guarded by two large, sub-equal scales, which are longer than wide and rounded at tip; the outer one overlies the base of the lowest arm spine and often is hard to make out. Color nearly white; disk skin yellowish; tentacles deep brown.

Laysan Island. Stat. 4. 200 fms. April 10, 1923. One specimen. Type specimen, B. P. Bishop Mus. Col. No. 478.

This is a very well characterized species, the five arms, with four arm spines on each side arm plate easily distinguishing it from the genotype, *O. hexactis,* which occurs in deep water on the Japanese coast. The same characters distinguish it from the West Indian *O. secundus* Koehler, but it is possible that *secundus* is not genetically related to the Pacific species, for the presence of flat, visible radial shields, the form and position of the upper arm plates, and the single, pointed tentacle-scale make me very doubtful about retaining the West Indian species in Ophiologimus.

Amphipholis squamata (delle Chiaje).

This ubiquitous little brittle-star is represented in the present collection by five small specimens, having the disk 2 mm. across or less; those from Wake Island are very small with the disk less than a millimeter across, but they seem to be typical *squamata.* Their occurrence at that

[10] *Quadrispinus*=four-spined, in reference to the number of arm spines.

isolated spot is certainly notable evidence of the extraordinarily wide range of the species.

Three specimens from Laysan Island of which one found in ball of seaweed at the waters' edge, another at a depth of two fathoms.

Two specimens from Wake Island.

Ophiactis savignyi (M. and T.).

This little brittle-star, while not so widely distributed as the preceding, is very common throughout the tropics and the presence of 81 specimens in the present collection is therefore quite to be expected. They range in size from 1 to 5 mm. across the disk.

Four specimens from Wake Island, one from Johnston Island, and 76 from Oahu Island.

Ophiothrix demessa Lyman.

It is interesting and a little surprising, in view of the numerous species of Ophiothrix and their abundance in the tropics, to find this the only representative of the genus in the collection. There are nine specimens at hand with disks ranging from 5 to 10 mm. in diameter. They show two quite distinct types of coloration; the disk is blue-gray and the arms blue and white, or the disk is pale gray or yellowish and the arms are light red and white. They thus look so unlike that it is hard to believe they are the same species. It is possible that the color difference is associated with some difference in habits or habitat.

Two specimens (one blue, one reddish) from Pearl and Hermes Reef; three specimens from Laysan Island, 12-20 fathoms; two from Oahu Island and two (one blue, one reddish) from Molokai Island.

Ophionereis porrecta Lyman.

This well-known Hawaiian species is represented by only two specimens. One 7 mm. across the disk from Ocean Island; the other 15 mm. across the disk from Kawela Bay, Oahu Island.

Ophiocoma brevipes Peters.

There are only four specimens of the typical form of *brevipes,* light colored with more or less green.

One adult specimen, 15 mm. across the disk and with arms only 60-65 mm. long, was taken at Pearl and Hermes Reef, Southeastern Island. One, 14 mm. across the disk, the oral shields with distinct reddish markings, from Midway Island; a very small specimen from Ocean Island, and one, 7 mm. across the disk, from Laysan Island.

Ophiocoma brevipes var. **variegata** E. A. Smith.

There are twenty-four specimens of *brevipes* in the collection which show the dark and variegated coloration of this form. A few approach the extreme form, var. *insularia,* but none are really fair representatives of it and I think all may be considered as *variegata.*

Nine specimens ranging from 12 to 24 mm. across the disk were taken by the Tanager Expedition at Laysan Island; one was taken at Ocean Island and two at Necker Island. In the collection are also 12 specimens, ranging from 2.5 mm. to 28 mm. across the disk, from Oahu.

Ophiocoma erinaceus M. and T.

There are thirteen specimens of this black brittle-star, all perfectly typical, and none showing any approach to *scolopendrina* or *schoenleinii.*

One small specimen was taken at Ocean Island; three from Laysan Island, two of which were taken at depths from 12 to 15 fathoms; one from Necker Island; three from Johnston and two from Wake Island. There are also two specimens, 23-25 mm. across the disk, from Oahu, and one huge specimen, 30 mm. across the disk and with arms about 140 mm. long, from Palmyra Island. This is a very typical specimen and the largest I have ever seen or that has been recorded.

Ophiocoma parva H. L. C.

The following records for this little species, first described from Torres Strait, greatly extend its known range but the material throws no light on the validity or relationship of this very small species.

One specimen was taken by the Tanager Expedition at Pearl and Hermes Reef; one at Lisiansky Island; two at Laysan Island and eight at Wake Island. One specimen from Palmyra Island is also included in the collection.

Ophiocoma pica M. and T.

This handsome and well marked species was taken at the following stations:

Two small specimens, 8-12 mm. across disk from Pearl and Hermes Reef; one beautiful little specimen, only 3.5 mm. across disk, with the alternate arm segments white (golden yellow in life, no doubt), from Laysan Island; two specimens, 15 mm. across disk, from Ocean Island; one specimen, 11 mm. across disk from Wake Island; one specimen, 11 mm. across disk from Johnston Island; one specimen, 15 mm. across disk, from Honolulu Harbor, ten fathoms.

Ophiocoma scolopendrina (Lamarck).

It is a little curious that this species is represented by only two typical specimens, 18-23 mm. across disk and with arms 110-140 mm. long, from

Palmyra Island. It is perhaps because of its peculiar and often secretive habits that it was not taken at the other islands.

Ophiarachnella parvispina [11] sp. nov. Plate X, *A, B.*

Disk 5 mm. in diameter; arms 25-30 mm. long. Disk circular, a little swollen, covered with a close, fine granulation (200-300 granules to the square millimeter); no bare plates anywhere except the small, circular radial shields which are .25-.30 mm. in diameter and are well separated from each other; the distance between the two of the same radius is double the diameter of the shields, or more; the interradial distance between two is more than double the radial. Arms rather slender, cylindrical at base but becoming quite flat at the blunt tip. Upper arm plates somewhat triangular with the proximal angle of the first 20-25 truncated and the distal margin broadly curved; approximately the first 20 are more or less in contact but beyond the middle of the arm separated by the side arm plates.

Interbrachial areas below covered by a fine granulation like that of the disk. Oral shields wider than long, rounded pentagonal, wider without than within; the madreporite is rounded, triangular and scarcely, if any, larger than the others. Supplementary oral shields present back of each oral shield, except the madreporite; they are small, twice as wide as long, their width being ½-⅔ that of the oral shield. Adoral plates relatively rather large, rounded triangular or very unequally tetragonal, completely separating the oral shield from the first under arm plate. Oral plates completely hidden under fine granulation like that of the disk. Oral papillae eight or nine on a side, penultimate much the largest, truncate, the inner ones more or less pointed. Teeth concealed. Genital slits about equal to three arm joints, though in some of the interradii they look much less. No pores between basal under arm plates.

First under arm plate relatively large, diamond shaped, wider than long, with distal angle rounded. Succeeding plates longer than wide (the first two very slightly so) either hexagonal with distal margin broadly curved or octagonal with distal angles rounded; the lateral margins are a bit concave; the first thirty plates are more or less broadly in contact but beyond that they become more and more separated by the side arm plates. Side arm plates rather large, bearing seven arm spines (eight at very base of arm, six at middle, five distally) of which the lowest may be a trifle the longest but does not equal the arm segment; usually the lowest two or three are subequal; they are blunt, while the upper ones are distinctly shorter and are sharply pointed; all are closely appressed to the arm. Tentacle scales two, inner larger, outer overlapping base of lowest arm-spine. Color, disk and whole oral surface nearly white with the radial shields no darker; each arm with 8-10 dusky bands across the upper surface; these bands usually include every third upper arm plate and the upper ends of the adjoining side arm plates, but they are often wider than that.

Wake Island. One specimen. Type specimen Bishop Museum Collection No. 477.

This little brittle-star has puzzled me because it is so similar superficially to *Ohiopezella spinosa* on the one hand, and to several species of Ophiarachnella on the other. But the very evident radial shields and the small number of arm spines show it is not an Ophiopezella, while the size, shape and color of the radial shields, the very fine granulation of the disk

[11] *Parvispinus*=having small spines, in reference to the fact that the arm spines are very much smaller than in nearly related species.

and the number and size of the arm spines make a combination of characters quite unlike that of any Ophiarachnella as yet described.

Ophioplocus imbricatus (M. and T.).

The discovery of this species at Wake Island is of interest, as the range is thus extended considerably to the northeast.

Wake Island. Three specimens, 15-19 mm. across disk.

ECHINOIDEA

(Sea-urchins. Echini.)

There are 152 sea-urchins in the collection, mostly adult and well preserved, but some are in poor condition. They represent 21 species, of which one is new to science, but most of the others are well-known Indo-Pacific species.

Eucidaris metularia (Lamarck).

All but one of these specimens is young, ranging from 3.5 to 15 mm. in diameter. The single adult is a bare test, 24 mm. through, with seven coronal plates in each column. It is interesting to note that the smallest specimen has four coronal plates in each column while one, 14 mm. in diameter, has but five, with the sixth just appearing in some columns.

Two specimens were collected off Laysan Island at depths from 12 to 15 fathoms, and one specimen from each of the following localities: French Frigate Shoals, Pearl and Hermes Reef, and Ocean Island. There is also a small specimen in the collection from Palmyra Island and one from Oahu.

Centrechinus paucispinus (A. Ag.).

The two young specimens are of great interest because the spines are unicolor (pale purplish-red) and not banded as they are in the young of the West Indian species of Centrechinus. If this proves to be constantly true of *paucispinus,* it is a good additional specific character.

One fine, typical adult, 68 mm. in diameter, was collected from Laysan Island and two young specimens from Oahu Island. Of the Oahu specimens, one is 9 mm. in diameter, with spines 32 mm. long; the other is 11 mm. in diameter and has spines 45 mm. long.

Echinothrix calamaris (Pallas).

There is a single fairly typical example of this species, 40 mm. in diameter, with spines 50 mm. long, from Palmyra Island.

Echinothrix diadema (L.).

Of the seven specimens examined, three are quite young and none is full grown.

One fine young specimen from Johnston Island, 13 mm. in diameter, has primary spines 21 mm. long.

Two small adults from Wake Island are 52-57 mm. in diameter with the primary spines somewhat shorter.

One adult, 52 mm. in diameter, from Pearl and Hermes Reef, collected by the Tanager Expedition, April, 1923, is partly bleached and some of the primaries are brown tipped. A second specimen, probably from the same place, has the bleaching and the brown tips even more extensive. It is difficult to decide whether the specimens were in this condition when collected, as a result of exposure to the sun and air, or whether the bleaching and discoloration were produced by some accidental means after collection. The appearance indicates treatment by some strong alkali.

Two young specimens, 12-19 mm. in diameter, from Palmyra Island, are very much like *calamaris*. The ambulacral primaries are very faintly banded, the central cavity of the large primaries very conspicuous, but as these spines are longitudinally ridged and have no distinct circles of minute teeth, I think I am safe in calling these individuals young *diadema*.

Lytechinus verruculatus (Ltk.).

A bare test, 19 mm. in diameter, and a smaller but fine specimen of 14 mm., are in the collection from Oahu Island. On the bare test the dark green markings are very plentiful. The primary spines of the smaller specimen are faintly banded with brown, but the bands are often quite indefinite.

Toxopneustes maculatus (Lamarck).

The presence of a specimen of this rare sea-urchin in the collection gives me the opportunity to describe certain features lacking in the bare tests that have hitherto been known. This individual is small, only 26 mm. in diameter and 13 mm. high, but it is in excellent condition with practically all of the spines in place. It was taken at Palmyra Island.

The abactinal system is 4.5 mm. across, of which the periproct is 2 mm. Oculars I and V are fully insert. There are no genital pores present save in genital five where a small one is distinctly seen. The peristome is nearly 14 mm. across, and is quite heavily plated but its appearance indicates that in the adult the distal portion has the plates more or less dissociated. The buccal plates are rather small and about equally separated from each other radially and interradially; they bear a number of ophicephalous pedicellariae.

The interambulacra are about 10 mm. wide at the ambitus and the ambulacra not quite 8 mm. The pore-pairs are in very regular arcs of three. The primary spines are short, relatively stout and quite blunt; few exceed 6 mm. in length. Pedicellariae are abundant but are either globiferous or ophicephalous; I found a single broken triphyllous but not even one tridentate. The globiferous are conspicuous abactinally as in *pileolus* and have the same membrane full of dumb-bell shaped particles; the valves are 1.25-1.50 mm. long and resemble in form those of *pileolus*. The ophicephalous have valves .45-.65 mm. long (with .15-.25 mm. more for the

"loop") and the width of the blade is about three-fourths of its length; the margin is coarsely crenulate. The single triphyllous pedicellaria has valves about .25 mm. long, almost flat at tip; the width at tip equals the length while basally it is a little more than half as much. The spicules of the tube-feet are just like those of *pileolus*.

The coloration of this specimen is typical. The test is white with a distinctly greenish tinge; just above the ambitus it is encircled by a band of bright violet about 5 mm. broad; the abactinal system is pale greenish with the periproct pure white and an area, extending out from the genito-ocular ring for 3-4 mm., light violet. Spines whitish with usually faint indications on the large ones of banding with pale green. Wherever the test is violet the spines borne thereon are violet, at least at base, though they are usually braodly tipped with pale greenish and often show one or two faint lighter bands. Actinally most of the primaries are violet, though they are more or less tipped with white and show more or less evident traces of light bands. The globiferous pedicellariae on the violet areas are quite deeply violet colored, even to the very calcium carbonate of which the valves are composed.

Pseudoboletia indiana (Mich.).

There are half a dozen specimens and some fragments from the following islands:

Two specimens about 44 mm. in diameter, in rather poor condition, from Pearl and Hermes Reef; one has the primaries dirty whitish, many tinged basally with purplish-red; the other has the primaries purplish-red, dark basally, and light at tip.

Fragments of a bare test, 37 mm. in diameter, from Midway Island.

Fragments of a bare test, 69 mm. in diameter, from Ocean Island.

One specimen, 50 mm. in diameter, in poor condition, from Ocean Island. The spines are deep purplish-red, barely tipped with whitish.

One fine, bare test, 69 mm. in diameter, from Ocean Island.

One nearly bare specimen, 46 mm. in diameter, from French Frigate Shoals.

Tripneustes gratilla (L.)

There are seven specimens of this widespread species from the following islands; with the exception of one of the small specimens from Oahu, which has many primaries white, they are all uniformly deep purplish-black: one specimen, 109 mm. in diameter, from Laysan; two specimens, 104 and 109 mm., from Johnston Island; one small specimen, 31 mm. in diameter, from Palmyra Island; two small specimens, 23-25 mm., from Oahu; one specimen, 92 mm. in diameter, from French Frigate Shoals.

Echinostrephus aciculatum A. Ag.

This curious rock-boring urchin is represented by seven dark-colored specimens of small or moderate size and by the fragments of a bare test. Those from Pearl and Hermes Reef are a trifle lighter than the others, but still belong to the bronze-colored form.

Two specimens, 15-18 mm. in diameter from Pearl and Hermes Reef. One specimen, 19 mm. in diameter, from Wake Island; two specimens, 13-15 mm. in diameter, from Johnston Island; fragments of a bare test, 39 mm. in diameter, from Midway Island. This is the largest individual of Echinostrephus that has yet been recorded. One bare test, 21 mm. in diameter, from Ocean Island; one specimen, 16 mm. in diameter, from Laysan, 12-15 fathoms.

Parasalenia gratiosa A. Ag.

There are seven specimens from Palmyra Island, ranging from 9 by 7 mm. to 26 by 22 mm. The three smaller specimens have spines 7-11 mm. long, faintly banded and no tubercles on the genital plates. The larger specimens have the primaries 27-30 mm. long, and a tubercle on 3, 4, or 5 genitals. The anal plates on the small specimens are 3, 4, and 5 in number and in the large specimens, 3, 4 (plus one very small), 4 (plus 6 small), and 7 (plus 2 small).

Echinometra mathaei (Bl.).

The 23 specimens of this very common Indo-Pacific sea-urchin show much diversity in size and color. The largest is a bare test 58 mm. long, 48 mm. wide and 32 mm. high. The smallest is but 10 mm. long. A number have the handsome light tipped spines, at one time supposed to distinguish a species, *picta,* and several others are quite green, very different from the gray, reddish or brown shades of the common run of specimens. There is much diversity, too, in the character of the spines, for while these are usually quite slender and pointed, in a few specimens they are short and stout, and resemble in form those of typical *oblonga.*

Specimens collected by the Tanager Expedition include one from each of the following localities: Pearl and Hermes Reef, French Frigate Shoals, Ocean, Midway, Gardner, Necker, Johnston and Wake islands; three from Nihoa, and four from Laysan Island. There are also eight specimens from Palmyra Island in the collection.

Echinometra oblonga (Bl.).

In spite of Döderlein's insistence on the generic distinctness of this form, the more echinometras I examine, the more dubious I am whether *oblonga* is really entitled to recognition as a species. The only constant character is color. In other words by arbitrarily calling all "black" echinometras from the Indo-Pacific region *oblonga,* the form can be readily separated from *mathaei.* The color seems to be, in dry specimens, a very dark purple rather than a real black, however. The matter of the abactinal tube feet and their spicules deserves careful study in fresh material. In

the usual dry specimens I find it a practical impossibility to obtain satisfactory pedicels for study from above the ambitus, but such observations as I have made lead me to believe that the same diversity will be found to exist in the spicules as we find in color and spines. Meanwhile we may call the dark purple or black Echinometras, particularly those with short, thick spines, *oblonga*.

In the collections examined are thirteen from the following islands: one small specimen from Wake Island, one specimen from Johnston Island, one small and one superb typical specimen from Necker Island, three specimens from Nihoa, one large specimen from French Frigate Shoal, two large specimens from Gardner Island, two large specimens from Laysan, one small, dubious specimen from Oahu.

Podophora atrata (L.).

This is one of the well-known and characteristic sea-urchins of Hawaii. The specimens in the present collection range from 23 to 65 mm. in length. The color for the most part is purple but the marginal spines, which are often quite long (.25-.35 of test length), are frequently quite distinctly green.

The collection includes one specimen from each of the following localities: French Frigate Shoals and Gardner Island; three from Nihoa and three small specimens from Oahu.

Heterocentrotus mammillatus (L.).

This is the characteristic "slate-pencil" urchin of the Hawaiian group and the material at hand calls for no special comment. The collection consists of one large specimen from French Frigate Shoals, one superb specimen, 85 mm. long and primaries about 100 mm., from Laysan, fragments of a bare test from Ocean Island, fragments of a bare test from Laysan, two superb specimens about 83 mm. long from Johnston Island, primaries about 100-115 mm. with prismatic orange-colored tips, one bare test from Palmyra Island only 17 mm. long and not positively identifiable, one small, broken test from Palmyra Island, one very young specimen, 9 mm. long by 8 mm. wide, from Palmyra Island, one good adult specimen from Necker Island, with blunt, ridged primaries, having a light ring near tip, one bare test, 73 mm. long, from Midway Island.

Heterocentrotus trigonarius (Lamarck).

It is rather remarkable that this species was found at Wake Island and at no other island visited but all the available evidence indicates that it does not occur anywhere in the Hawaiian area. Two fine adults, deep purple

in color, the larger about 75 mm. long with primaries 100-115 mm., from Wake Island.

Clypeaster eurypetalus sp. nov. Plate XI, *A, B, C.*

Length, 112 mm.; breadth, 88 mm.; height, 39 mm.; mouth sunken 16 mm. below the sides of the test. Test moderately high, the sides rather steep, somewhat flattened on top and rather markedly flattened in the sloping posterior interradius; there is no real margin whose thickness can be measured. Interporiferous areas of petals slightly elevated above the poriferous areas and the interambulacra. Test walls very thick and solid; dorsally the thickness is 2.5 mm., at the ambitus it is 3.5 mm. and near the mouth it is 1.5 mm. Tuberculation of test fairly uniform with 100-125 primary tubercles per sq. cm. of test surface; abactinally the tubercles are smaller and less sunken than at the ambitus and orally, and hence they seem to be less numerous; ridges between the pore-pairs of the petals with 2-4 small but distinct, usually well-spaced primary tubercles; miliary tubercles low, very numerous, granule-like. Abactinal system missing. Unpaired petal with about 50 normal pore-pairs on each side and 7-10 very minute pairs at the proximal end, the petal thus appears to begin 4-5 mm. from the ocular plate; it is 51 mm. long (from ocular pore to tip) and 35 mm. wide at the completely open tip; poriferous areas only 4 mm. wide where widest, proximal to the tip. Anterior petals as wide as long, about 41 mm. whether measured from ocular pore to tip or across the fully open tip; the proximal pores and the width of the poriferous areas as in the unpaired petal. Posterior petals as long as the unpaired petal and 2-3 mm. wider, with the proximal pores and poriferous areas very similar. Peristome 6-7 mm. across, central. Periproct only 4 mm. long, 4.5 mm. wide and with its posterior margin only 2 mm. from the end of the test. Spines and pedicellariae missing. Color pale brown.

Holotype, No. 14x. Pearl and Hermes Reef. April, 1923. Bishop Museum Collections No. 479.

This is the best marked and most notable recent Clypeaster that has come to light in many years. It cannot be confused with any hitherto known, for the enormous petals are unique. In *C. rosaceus* and *C. pallidus*, the petaloid area occupies 60-65 percent of the abactinal surface of the test or in some extreme cases a little more, but in other members of the genus it rarely exceeds 55 percent and is usually under 50. In this new Hawaiian species, however, more than 80 percent of the upper surface is occupied by the amazingly wide petals. Another notable feature is the very small periproct, and the thickness of the walls of the test is also noteworthy. The appearance of the specimen indicates that it had been dead for some time before it was collected and there seems to be no way of determining whether it was washed up onto the reef flat from deeper water, after death, or whether its normal home is in the shallow water of the reef flat.

It is noteworthy that this new form is more nearly allied to *rosaceus* and *pallidus*, the typical Clypeasters of the West Indies, than to any species as yet known from the Pacific and in the ultimate breaking up of the unnatural and unwieldy genus, it must either be placed with them or made the type of a genus by itself. I cannot agree with Lambert and Thiéry and with Koehler in placing the species *australasiae* and *japonicus* in the same section of Clypeaster as *rosaceus* and *pallidus*. But the details of the matter need not be entered into here.

Name derived from Ευρυς=broad+Πεταλον=petal, in reference to the excessively wide petals.

Clypeaster reticulatus (L.).

This common Hawaiian clypeastroid is represented by three bare tests, 25-28 mm. long, from Midway Island and by one bare bleached test, only 15 mm. long from Oahu.

Fibularia australis Desm.

There are five bare tests of this uncommon little urchin from Midway Island. They range from 8.5 by 7 by 2.5 mm. to 15 by 12 by 6 mm.

Echinoneus cyclostomus Leske.

This tropicopolitan species is well represented by specimens from half a dozen islands. They show the usual diversity of form, the width of the test ranges from 68 to 83 percent of the length and the height from 41 to 56 percent. Most are bare tests.

Specimens of the collection include three from Ocean Island, one from Midway Island, two from Laysan Island, two from Wake Island; two bare tests from Palmyra Island and one fine specimen from Fanning Island.

Metalia spatagus (L.?).

A young spatangoid from Oahu, 30 mm. long, 22 mm. wide and 16 mm. high seems to represent this well-known species.

Brissus latecarinatus (Leske).

This fine big spatangoid was taken at three of the islands. Two specimens (bare tests) from Laysan; one is only 30 by 22 by 15 mm. but the other is 90 mm. long, 66 mm. wide and 45 mm. high; the apical system is only 28 mm. back from the anterior end and at that point the test is 43 mm. high; one small bare test from Ocean Island, 25 by 20 by 14 mm.; one fine specimen from Ocean Island, 115 by 92 by 70 mm.; one very large bare test from Laysan, 154 by 131 by 78 mm.

The apical system is only 30 mm. from the anterior end and the test is as high there as 75 mm. farther back. The test has the appearance of having been gnawed, probably by rabbits with which Laysan was over-run.

One large bare test from Johnston Island, 111 by 87 by 58 mm. The apical system is 39 mm. back from the anterior end and the test is 6 mm. lower there than 40 mm. farther back.

HOLOTHURIOIDEA

(Sea-cucumbers. Holothurians.)

There are 182 holothurians in the collection mostly in a mediocre or poor state of preservation but fortunately none are decalcified and hence identification has been possible. Of the 22 species represented, none are new or

of any particular interest. Of course, considerable light is thrown on the distribution of the species. It is interesting to note that six of them are not listed by Fisher [12]. It should be added, however, that not one of these six was taken in the Hawaiian group, but all are from islands far to the south or west.

Euapta godeffroyi Semper.

There are three specimens, as follows: Two specimens, one 90 mm., the other 190 mm. long, from Wake Island. Both are variegated with dark and light shades of brown but the larger is much the darker colored. One specimen, 200 mm. long and 8-10 mm. in diameter, from Palmyra Island, is rather pale brown, with indistinct variegation.

Polyplectana kefersteinii (Sel.).

One specimen, in fragments, from Johnston Island, 22 tentacles. One specimen from Oahu, 115 mm. long by 8 mm. in diameter, red-brown in color; 24 tentacles.

Synapta maculata (Ch. and Eys.).

A fine specimen of this remarkable synaptid from Palmyra Island, is 650 mm. long by 25 mm. in diameter. Almost wholly white, with only slight indication of markings. Close examination shows this to be due to the excessive development of the miliary granules in the skin. The anchors and plates are literally buried in the billions of these minute spicules. I have never seen a specimen comparable with this one in this particular.

Leptosynapta ooplax (v. Marenz.).

There are two small synaptids from Fanning Island, which seem to represent this species, though they have but ten tentacles each. They are only 40-50 mm. long and 2-3 mm. in diameter, so they are obviously young and it is probable that this accounts for the full number of tentacles not having been acquired. They are pale flesh color, and the calcareous particles, though typical, show indications of slight decalcification.

Chiridota rigida Semper.

The specimens of Chiridota show great diversity in color and considerable in the number and distribution of the wheel papillæ. In some there are no papillæ in the ventral interambulacra while other specimens show wheel papillæ numerous all over the body. This seems to be a matter of

[12] Fisher, Walter K., The Holothurians of the Hawaiian islands: U. S. Nat. Mus. Proc., vol. 32, pp. 637-744, 1907.

age (not necessarily of size, however), the younger individuals having the fewer papillæ.

Nine fragments from Wake Island in very poor condition but calcareous particles, typical. Color deep brownish-red. Three good specimens, pale brown with a strong reddish tinge, about 30 mm. long by 5 mm. in diameter, from Johnston Island. Five small, white specimens, 20-25 mm. long, 3-4 mm. in diameter, with few wheel papillæ, from Palmyra Island. The absence of pigment does not seem to be artificial. It is possible here is a distinct color variety. The calcareous particles are typical.

Holothuria arenicola Semper.

The eight specimens show great diversity in color and size but the calcareous particles are as a rule quite distinctive.

Two poor specimens from Laysan, 60-90 mm. long; one small specimen only 20 mm. long, from Wake Island; one specimen, 125 by 30 mm., from Fanning Island, has no big dark spots in evidence; one specimen from Palmyra Island, 110 by 20 mm., is quite white with the two series of dorsal spots a very bright red-brown. There are also two poor, bleached, young specimens, 20-25 mm. long, from Palmyra Island. One specimen, 110 by 15 mm., from Kahana Bay, Oahu; typical except that many tables have the disk more than usually developed, with a marginal series of holes.

Holothuria atra Jäger.

The dozen specimens of this species show little diversity, save in size, ranging from 30 to 275 mm. in length. One specimen from Laysan has lost all of its pigment and is nearly white, but the calcareous particles are uninjured; it is very flat and in poor condition and has apparently been bleached without any decalcification.

The collection includes one specimen from Laysan Island, 75 mm. long, white; one from Johnston Island, 100 mm. long; six from Wake Island, ranging from 30 to 225 mm. long; one from Johnston Island, 100 mm. long; two from Fanning Island, 75 to 80 mm. long; and one specimen, 100 mm. long, from Oahu.

Holothuria cinerascens (Brandt).

This very well marked species is represented in the collection by the following sixteen specimens.

Three young ones from Oahu, 12-40 mm. long; the smallest has some tables with well-developed disk, having a marginal series of holes, and about 20 small teeth on the spire, but other tables are like those of adults.

Three specimens, 100-150 mm. long and dark brown, somewhat lighter below, taken by the Tanager Expedition at Laysan Island, and one poor

specimen, 90 mm. long, from Necker Island. There are also included the following from Oahu: four specimens from Waikiki reef, two of which measure 125 mm. long and are of a rather bright reddish brown with a purple tinge, and two rather poor specimens 100 mm. long, showing no trace of red in the coloration, but with the calcareous particles unmistakable; five young specimens, 35-70 mm. long, dark brown, from Kahana Bay, and three other young specimens from Oahu, 12-40 mm. long, the smallest having some tables with well developed disks, marginal series of holes and about 20 small teeth on the spine, but the other tables are like those of adults.

Holothuria edulis Lesson.

A single typical specimen of this fine species appears from Wake Island. It is 190 mm. long by 30 mm. in diameter. The species is not known from the Hawaiian group.

Holothuria fuscorubra Theél.

The calcareous particles of this species are similar to those of *pardalis* but they are much more scattered and the tables are noticeably smaller. The coloration is also quite different from anything shown by that variable species.

The collection contains a specimen, 60 by 15 mm., from French Frigate Shoals, and one specimen, 65 by 15 mm., of bright brown coloration, from Kahana Bay, Oahu.

Holothuria impatiens (Forskål).

This widespread and common species is represented by only four specimens: one typical specimen, 140 mm. long, was taken by the Tanager Expedition at Laysan Island and one specimen 45 mm. long at Johnston Island; two specimens from Oahu in the collection, one a bright brown color, 30 by 15 mm. with typical calcareous particles, and a larger specimen about 100 mm. long.

Holothuria lineata Ludwig.

There are two holothurians from Johnston Island about 70 mm. long by 15-20 mm. in diameter, which agree well with the description of this species, but have no lines on the radii. The calcareous particles are obviously different from typical *pardalis,* so they cannot be referred to that species, though undoubtedly very near it.

Holothuria monocaria Lesson.

The twenty specimens of this species show considerable diversity in color, as well as in size, but the calcareous deposits are quite distinctive.

They include one young specimen, 30 by 12 mm., from French Frigate Shoals; two specimens from Lisiansky Island, 85 mm. long by 30 mm. in diameter, and the other 35 by 18 mm. They are unlike in coloration, but the calcareous deposits are identical; four specimens from Wake Island, one 30 by 12 mm., the other three about 70 mm. long, typical in color, dark brown above, yellowish below, with papillae and pedicels yellow; three specimens about 75 mm. long from Johnston Island. There are also three specimens, 80-90 mm. long and of typical coloration, from Fanning Island; and seven young specimens, 25-50 mm. long from Palmyra Island.

Holothuria pardalis Sel.

The twenty-five specimens I am referring to this species agree well in the size and form of the calcareous particles, but in their distribution, and in the color, texture and appearance of the body wall, there is the greatest diversity. In only two or three specimens are all the buttons arranged in circles or heaps, but in many others most of them are thus accumulated; in still others only a small part are thus collected. I think that fully adult specimens are likely to have the rings or heaps of buttons well marked and inclusive of nearly or quite all the buttons, but young and half grown specimens show a more uniform distribution of the calcareous particles. The color and texture of the body wall naturally are influenced by the number and degree of accumulation of the buttons. There is no doubt that *pardalis* is closely related to *lineata* and *fuscorubra,* as well as to several other nominal species. The whole group needs a careful revision.

The collection of the Tanager Expedition includes two typical specimens, 40-60 mm. long, from Laysan Island; one specimen, 40 by 8 mm., from Wake Island; six specimens, 35-75 mm. long, from Johnston Island. There are also thirteen specimens from Oahu; two young specimens from Palmyra Island and one small, bleached specimen from Fanning Island.

Holothuria pervicax Sel.

There are but few specimens of this widely distributed species. One specimen, 80 by 20 mm., from Fanning Island, is conspicuous by the large light colored spots with which it is marked. One large but strongly contracted specimen from Laysan. Two small specimens from Oahu; calcareous deposits very abundant.

Holothuria rugosa Ludw.

There is a fine, typical specimen of this species, 130 mm. long by 15 mm. in diameter, from Fanning Island. The species is not yet known from the Hawaiian islands.

Stichopus chloronotus Brandt.

This known holothurian was found at only two of the islands. Its occurrence at the leeward Hawaiian islands is more than ever in need of confirmation.

Four specimens, 170 by 25 mm. to 240 by 40 mm., were taken by the Tanager Expedition at Wake Island. One of these is the largest recorded, for in life it was probably well over 300 mm. long and may have been 350 mm. Three specimens, 75 to 100 mm. long, from Palmyra Island, are also included in the collection.

Stichopus variegatus Semper.

This species was not previously known north of the Equator, east of the Caroline Islands. The following records are therefore of great interest.

Five small specimens, 80-90 mm. long and 20 mm. wide, from Fanning Island, seem to belong to this species. The coloration is very dark brown, almost black, much darker than usual for *variegatus,* and the C-shaped bodies are only 30-50 mm. long; some of the rosettes are as long as the C-shaped bodies. The tables are similar to those of adult *variegatus* and I think the small size of the C-shaped bodies may be simply a youthful character. One small specimen from Palmyra Island is also dark brown. Two large specimens from Wake Island, about 225 mm. long by 40 mm. wide are very pale brown and lack large papillae on the back. They are quite suggestive of Semper's variety *heermanni,* but I do not refer them to it as I have seen no authentic examples and am dubious as to its status.

Actinopyga maruritiana (Q. and G.).

This is evidently the characteristic Actinopyga of the northern, eastern Pacific islands, as there are ten specimens at hand from six islands.

On the Tanager Expedition one specimen 115 mm. long was taken at Necker Island. It is speckled all over the back with dirty whitish spots, and is whitish below, save for the brown pedicels. One typical specimen, 150 mm. long, was collected at Johnston Island and two specimens, 160 by 35 mm. and 210 by 45 mm., were taken at Wake Island. Those from Wake Island are remarkable for having the area around the cloacal opening and one on the back very light colored as in *A. lecanora.*

There are included in the collection four specimens from Oahu; one, 70 by 30 mm., is very light colored and has only 21 tentacles; two, 80-140 mm. long, are reddish brown, speckled with large dirty whitish spots; and one very young specimen, 20 by 7 mm., with the anal teeth rudimentary and the calcareous deposits very handsome, because of the conspicuous and abundant dendritic projections on the rods and the fat appearance of the rosettes.

There is also a small specimen, 43 by 27 mm., from Palmyra Island which is notable for the excessively numerous calcareous particles which even ventrally are notched and branched to an unusual degree; very few oval bodies or short rods are perfectly smooth. The color of this young specimen is dirty whitish with two series of brown spots on the back and the crowded ventral pedicels are brown. There is also a very large specimen, 340 mm. long, with a very few and small markings of light color, from Fanning Island.

Actinopyga nobilis (Sel.).

This species was hitherto known only from the Hawaiian group; hence the following records are of considerable interest.

Two specimens were taken by the Tanager Expedition at Laysan Island; the largest, 280 mm. long by 210 mm. in circumference, is black with a few small, irregular, scattered light gray areas. The calcareous deposits are unmistakable.

One specimen, 65 mm. long by 20 mm., from Palmyra Island, is of great interest owing to its small size and probable youth. It is dull fawn color, with numerous minute spots and a number of small irregular blotches of dark brown; the pedicels are very numerous and so thickly speckled with dark brown that the whole lower surface appears to be dull dark brown. The lower surface is flat and sharply set off from the upper surface by a series of about ten large marginal tubercles on each side. Each dorsal radius is also occupied by a series of similar tubercles. This form and coloration is so different from the dark-colored adult which shows no sign of large tubercles that only the examination of the calcareous particles convinced me that this little holothurian is a young *nobilis*. The growth changes in this fine species are quite remarkable, therefore, as it develops from a light-colored, rather angular creature, with relatively large tubercles along the angles, into a huge, nearly black, holothurian with practically no angles and no tubercles.

Actinopyga obesa (Sel.).

This species was hitherto supposed to be confined to the Hawaiian group, so a specimen from Johnston Island is quite noteworthy.

The collection includes one specimen, 160 mm. long by 60 mm. wide, of very dark olive-brown coloration, from Laysan Island; and one specimen, 125 mm. long, from Johnston Island, which has the same nearly black coloration.

Actinopyga parvula (Sel.).

Although I refer a large number of specimens to this species, I confess frankly that I do not believe them Actinopygas in any natural sense. Their resemblance to *Holothuria captiva, difficilis,* and *frequentiamensis* is too close to be a mere coincidence and I do not believe that the presence of anal teeth warrants a wide separation from those species. The "teeth" are

difficult to demonstrate in specimens 10-15 mm. long. The 32 specimens before me range from 10 to 70 mm., but the last is exceptionally large, and few specimens exceed 50 mm. when preserved. The color is uniformly seal brown, though the smallest specimens may be very pale; one is nearly colorless. The epidermis is always rough and brittle with the crowded tables.

The Tanager collection includes one specimen from Laysan Island; two from Johnston Island, and four from Wake Island. There are also five adult specimens from Kahana Bay, Oahu; 19 young specimens from Palmyra Island, and one very young specimen from Fanning Island.

DISTRIBUTION

A comparison of the collections from the various islands, arranged by geographical groups, is both interesting and instructive.

I. THE EASTERN OR WINDWARD HAWAIIAN GROUP

OAHU

Ophiactis savignyi
Ophiothrix demessa
Ophionereis porrecta
Ophiocoma brevipes var. variegata
" erinaceus
" pica
Eucidaris metularia
Centrechinus paucispinus
Lytechinus verruculatus
Tripneustes gratilla
Echinometra oblonga
Podophora atrata
Clypeaster reticulatus
Metalia spatagus
Polyplectana kefersteinii
Holothuria arenicola
" atra
" cinerascens
" fuscorubra
" impatiens
" pardalis
" pervicax
Actinopyga mauritiana
" parvula

From Molokai are two specimens of *Ophiothrix demessa,* but there are no other species from that island or from any other, except Oahu, of the inhabited or eastern part of the Hawaiian group. Of the 24 species listed, nine or ten are particularly characteristic of the Hawaiian fauna, while an equal number range over nearly the whole Indo-Pacific region.

II. THE NECKER ISLAND GROUP

FRENCH FRIGATE SHOALS

Eucidaris metularia
Pseudoboletia indiana
Tripneustes gratilla
Echinometra mathaei
" oblonga
Podophora atrata
Heterocentrotus mammillatus
Holothuria fuscorubra
" monocaria

NECKER ISLAND

Ophiocoma brevipes var. variegatus
" erinaceus
Echinometra mathaei
" oblonga
Heterocentrotus mammillatus
Holothuria cinerascens
Actinopyga mauritiana

NIHOA

Echinometra mathaei
Echinometra oblonga
Podophora atrata

Although these lists include but thirteen species, three of them are not in the list from Oahu. There is no significance in this, however, for all are well-known Hawaiian species. The lists show that those who collected on these islands found sea-urchins not uncommon but brittle-stars and holothurians rare.

It may be well to add here the species from Gardner Island, although it is not, strictly speaking, in the Necker Island group.

Echinometra mathaei
Echinometra oblonga
Podophora atrata

These are the same species taken at Nihoa and are three of the most abundant and generally distributed echinoderms in the Hawaiian islands.

III. LAYSAN AND LISIANSKY GROUP

Ophiologimus quadrispinus
Amphipholis squamata
Ophiothrix demessa
Ophiocoma brevipes
Ophiocoma brevipes var. variegata
Ophiocoma erinaceus
" parva
" pica
Eucidaris metularia
Centrechinus paucispinus
Tripneustes gratilla
Echinostrephus molare
Echinometra mathaei
Echinometra oblonga
Heterocentrotus mammillatus
Echinoneus cyclostomus
Brissus latecarinatus
Holothuria arenicola
" altra
" cinerascens
" impatiens
" pardalis
" pervicax
Actinopyga nobilis
" obesa
" parvula

LISIANSKY ISLAND

Ophiocoma parva
Holothuria monocaria

This list of 27 different species no doubt gives a fair idea of the echinoderm fauna of Laysan, exclusive of course of the sea-stars. The Ophiologimus is a deep water form and hence not really a Laysan species. The occurrence of *Amphipholis squamata* is interesting but none of the other species are noteworthy. The list is characteristically Hawaiian, the two large Actinopygas being particularly representative.

IV. MIDWAY ISLAND GROUP

PEARL AND HERMES REEF

Ophiothrix demessa
Ophiocoma brevipes
" parva
" pica
Eucidaris metularia
Echinothrix diadema
Pseudoboletia indiana
Echinostrephus molare
Echinometra mathaei
Clypeaster eurypetalus

MIDWAY ISLAND

Ophiocoma brevipes
Pseudoboletia indiana
Echinostrephus molare
Echinometra mathaei
Heterocentrotus mammillatus
Clypeaster reticulatus
Fibularia australis
Echinoneus cyclostomus

OCEAN ISLAND

Ophionereis porrecta
Ophiocoma brevipes
" brevipes var. variegata
" erinaceus
" pica
Eucidaris metularia
Pseudoboletia indiana
Echinostrephus molare
Echinometra mathaei
Heterocentrotus mammillatus
Echinoneus cyclostomus
Brissus latecarinatus

The preponderance of echini and the entire absence of holothurians in these lists is remarkable. The collectors who visited this group of islands remarked upon the notable lack of holothurians. On the other hand, the sea-urchins were not uncommon. As a result the list of echini is very interesting. Of the eleven species, one is a remarkable undescribed Clypeaster and three others (*Pseudoboletia indiana, Echinostrephus molare, Fibularia australis*) are very characteristic Hawaiian species.

V. THE PALMYRA AND FANNING GROUP

PALMYRA ISLAND

Ophiocoma erinaceus
" parva
" scolopendrina
Eucidaris metularia
Echinothrix calamaris
" diadema
Toxopneustes maculatus
Tripneustes gratilla
Parasalenia gratiosa
Echinometra mathaei
Heterocentrotus mammillatus
Echinoneus cyclostomus
Euapta godeffroyi
Synapta maculata
Chiridota rigida
Holothuria arenicola
" monocaria
" pardalis
Stichopus chloronotus
" variegatus
Actinopyga mauritiana
" nobilis
" parvula

FANNING ISLAND

Echinoneus cyclostomus
Leptosynapta ooplax
Holothuria arenicola
" atra
" monocaria
" pardalis
Holothuria pervicax
" rugosa
Stichopus variegatus
Actinopyga mauritiana
" parvula

This list of 27 species is notable for the large number of holothurians and the absence of brittle-stars, only three Ophiocomas being preserved. Detailed examination of this list shows that eleven, more than one-third, of the species are not found in the previous lists. Evidently, then, this is a distinguishable fauna, which we may for convenience call the Palmyra fauna in contrast with the Hawaiian. Its most characteristic species is *Toxopneustes maculatus,* a well-marked and noteworthy sea-urchin, known

as yet only from the islands in the central Pacific.[13] Other species not occurring in Hawaii are *Ophiocoma scolopendrina, Parasalenia gratiosa, Synapta maculata, Leptosynapta ooplax, Holothuria rugosa* and the two species of Stichopus.[14] On the other hand, the Hawaiian lists show the following characteristic species lacking from the Palmyra fauna: *Ophiothrix demessa, Centrechinus paucispinus, Lytechinus verruculatus, Pseudoboletia indiana, Echinostrephus molare, Holothuria cinerascens* and *Actinopyga obesa.* Many other species occur in the Hawaiian fauna which are not known yet from the Palmyra-Fanning region, but they are of such general distribution in the Indo-Pacific region, it is probable that they will be found there ultimately.

VI. JOHNSTON ISLAND AREA

JOHNSTON ISLAND

Ophiactis savignyi
Ophiocoma erinaceus
" pica
Echinothrix diadema
Tripneustes gratilla
Echinostrephus molare
Echinometra mathaei
" oblonga
Heterocentotus mammillatus
Brissus latecarinatus
Polyplectana kefersteinii
Chiridota rigida
Holothuria atra
" impatiens
" lineata
" monocaria
" pardalis
Actinopyga mauritiana
" obesa
" parvula

Examination of this list shows that eleven of the twenty species occur in the Palmyra fauna and nine are not yet known from there while fifteen of the species occur at the Hawaiian islands proper and four others occur at Laysan. Only the dubious holothurian, *H. lineata,* is not yet recorded from the Hawaiian group. It is evident, therefore, that the Johnston Island fauna, in spite of its isolation, is identical with that of Hawaii.

VII. WAKE ISLAND AREA

WAKE ISLAND

Amphipholis squamata
Ophiactis savignyi
Ophiocoma erinaceus
" parva
" pica
Ophiarachnella parvispina
Ophioplocus imbricatus
Echinothrix diadema
Echinostrephus molare
Echinometra mathaei
" oblonga
Heterocentrotus trigonarius
Echinoneus cyclostomus
Euapta godeffroyi
Chiridota rigida
Holothuria atra
" edulis
" monocaria
" pardalis
Stichopus choloronotus
" variegatus
Actinopyga mauritiana
" parvula

When this list is critically examined, we find that of the twenty-three species, fourteen occur in the Palmyra fauna and nine are not yet known

[13] The record from *Bourbon* seems to me dubious. It certainly needs verification.
[14] The record from Hawaii of *S. chloronotus* is so dubious, it may properly be ignored.

from there, but only eleven occur at the Hawaiian islands proper, four more are found at Laysan and one more at Pearl and Hermes Reef. Of the seven species not found in the Hawaiian area, in the broad sense, three are found in the Palmyra fauna, three others occur south and west of Wake Island, and one is known as yet only from that island.

On the whole it seems clear from the analysis of these collections that the echinoderm fauna of the Hawaiian islands is a somewhat attenuated Indo-Pacific fauna which has added a number of endemic species. This fauna has reached the islands from the southwest via the Caroline and Marshall islands. Wake Island lying to the north of the Marshall Islands is more Indo-Pacific than is the Hawaiian area, as might be supposed from its position. The Palmyra fauna is also an Indo-Pacific fauna but evidently of a different stream than that which has flowed into the Hawaiian group, apparently coming in from the Gilbert and Ellice and the Phoenix islands. (Nothing whatever is known as to the echinoderms of the Phoenix and the Ellice islands, and little enough about those of the Gilberts.) As has already been shown, the Johnston Island fauna is distinctly Hawaiian.

CONCLUSIONS

Examination of a chart of the Pacific, showing the depths, reveals the interesting fact that the conformation of the ocean bottom gives impressive support to the conclusions reached by studying the composition of the echinoderm fauna. A long tongue-like area extends from the Marshall islands, northeastward towards Laysan, though not quite reaching the ridge on which that island lies. That ridge extending southeastward and forming the broad plateau on which the Hawaiian group stands also has Johnston Island near its southwestern corner. But a wide area of deep water separates it from the plateau on which Palmyra and Fanning islands stand. That plateau, however, is even more widely separated from the region of the Gilbert and Ellice islands, while it is, on the other hand, directly continuous with the area to the southeastward where lie the Marquesas (of whose echinoderm fauna we know nothing), the Tuamotus (of whose fauna we know a little) and the Society islands, whose echinoderm fauna is an attenuated Indo-Pacific fauna, of a different facies from that of Hawaii. These facts open up a most inviting field of investigation and make the student of echinoderms impatient to have the littoral fauna of the Marquesas, the Phoenix and the Ellice islands thoroughly investigated—not to mention Jarvis, Malden, Starbuck, Penrhyn, and Manihiki islands.

POLYCHAETOUS ANNELIDS

By
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The polychaetous fauna of the Hawaiian region is still very imperfectly known, only one paper (5) having been limited entirely to this area. McIntosh (3) records only one station near Honolulu at which a single Alciope was taken, and Chamberlain[15] in his report on the annelids collected by Alexander Agassiz, covers wide areas in the Pacific Ocean, but comes no nearer to Hawaii than the Gilbert Islands. The annelid fauna of the west coast of the United States, the South Pacific and of Japan, have received a good deal of attention, but that of the North-central Pacific has been much neglected. The Tanager collection is a small one, representing only a few families with one new species in each of the Syllidae and Phyllodocidae and it seems certain that it does not fairly represent the polychaetous fauna of this region. Dredging and towing are quite unsatisfactory methods for collecting polychaetes, especially in coral reef regions where the animals live in the corroded rocks and can be collected only by the somewhat arduous method of breaking the rock.

SYLLIDAE

Typosyllis crassi-cirrata new species.

A single specimen recorded as collected on seaweed at Laysan Island. The animal is 18 mm. long, the greatest body width being not over 1 mm.

The prostomium (fig. 10 *a*) is broadest across its anterior margin and the antero-lateral angles are rounded. The lateral margins are nearly straight and run backward at a slight angle with the main body axis. There is an antero-median marginal depression, obscured from above by the median tentacle. The palps are separate to the bases, are about one-third longer than the prostomium, concave on the inner faces and bluntly rounded at the ends. They are not shown in the drawing because covered by the cirri.

The median tentacle arises between the posterior pair of eyes. In this specimen it is shorter than the lateral ones and has only about ten joints, but

[15] Chamberlain, Ralph V., Mus. Comp. Zoology, Harvard Univ., Mem., vol. 48, 1919.

this is probably not an entire specimen. The paired tentacles arise from the anterior margin of the prostomium and are about four times as long as it is. In each there are about 25 joints, but toward the bases of the tentacles the boundaries of these are difficult to determine. The posterior eye on the left side is a compact mass of pigment while that on the right side is more diffuse and looks as if it were disintegrating. The anterior eyes correspond closely in character with the posterior ones, but both anterior eyes seem to lie directly ventral to the posterior ones, and to be imbedded in the tissues of the prostomium.

The dorsal tentacular cirrus on either side is very large and heavy and has from 40 to 50 joints. The ventral one is very much shorter and more slender, and extends to only a short distance beyond the tentacles. The dorsal

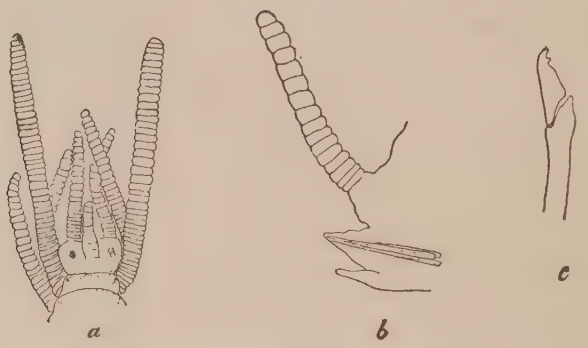

FIGURE 10. *Typosyllis crassi-cirrata,* new species: *a,* anterior end, X 28; *b,* parapodium, X 45; *c,* seta, X 250.

cirrus of the second somite is about as large as the ventral tentacular cirrus; that of the third somite equals the dorsal tentacular cirrus in size. From this point to the posterior end of the body is a regular alternation of long and short cirri in successive somites. There is a gradual decrease in absolute length in all of these cirri, those at the extreme posterior end being hardly longer than the body width. One pair of anal cirri, about equal in length to the posterior dorsal cirri appears.

The only pigmentation is in the form of small brown dots arranged as follows: at the boundary between pro- and peri-stomium, between the first and second somites in a transverse row, with a denser accumulation on either side on the dorsal surface of the base of the parapodium; traces of a similar row appear for about 30 somites, in most of which are also two transverse narrow bands of pigment spots lying on the dorsal surface of the somite; one on either side the mid-dorsal line.

The pharynx extends from somite 17 to somite 29.

A parapodium from the region of the thirtieth somite is shown in figure 10, *b*. This is one with the smaller dorsal cirrus, which in this case has 16 joints. The dorsal cirrus from the next somite is two and one-half times the length of this, is much heavier, and has 31 joints. The parapodium is pointed at the apex and has three aciculae. The ventral cirrus tapers to a blunt point and is much shorter than the parapodium. The setae are all compound with a short terminal joint. At first it appeared as though there were several types of setae but later study convinced me that the differences were due to abrasions of the margin. Some of the terminal joints had a definite apical and a subapical tooth with a smooth margin between the latter tooth and the base of the joint, while in others the subapical tooth is quite indistinct and the margin irregular. Figure 10, *c* represents the seta in what seems to be the characteristic form.

The type is in the Bishop Museum.

APHRODITIDAE

Iphione muricata Savigny.

Iphione muricata (Savigny). Grube, 1878. pp. 21 and 22.

Savigny's original paper was not accessible to me at the time of working over this collection, but a full description of this species is given in the paper by Grube above mentioned. Grube's specimen was collected in Zamboanga but the Hawaiian material seems to be certainly the same species. In an earlier paper (5),[15] I indentified as this species specimens collected by the United States Bureau of Fisheries. These are now in the National Museum and through the courtesy of Dr. Waldo L. Schmitt, came to me for comparison. I find that they are identical with the single specimen of this present collection though much larger. This single one is 40 mm. long.

One specimen collected in the vicinity of Lanai Island.

AMPHINOMIDAE

Eurythoe pacifica Kinberg.

Eurythoe pacifica Kinberg, 1857, p. 14.

The commonest species in the collection, three taken at Johnston Island; four at Wake Island; one at Palmyra Island; one at Necker Island; two at Laysan Island.

Hermodice pinnata Treadwell.

Hermodice pinnata Treadwell 1906, p. 1165, fig. 14.

Collected at Johnston Island.

HESIONIDAE

Hesione genetta Grube.

Hesione genetta Grube, 1878, p. 104.

This species was described by Grube in 1866 in a paper which was not accessible to me and I have identified it by the aid of the full description Grube gives in the above cited paper. The two specimens from Wake Island agree in every respect except in color, having dark brown instead of dark violet areas.

Collected at Wake Island.

NEREIDAE

Nereis (Perinereis) helleri Grube.

Nereis (*Platynereis*) *helleri* Grube, 1878, pp. 81 and 82.

Four collected at Johnston Island.

Nereis (Platynereis) kobiensis McIntosh.

Nereis (*Platynereis*) *kobiensis* McIntosh, 1885, pl. 34, figs. 3, 4. 5, and 6; pl. 16a, figs. 2, 3, and 4.

One collected at Lisiansky Island.

Heteronereis sp.

Collected at Pearl and Hermes Reef.

Fragments of a Nereis, taken at Laysan Island are marked "from shark's stomach" and some very young specimens too immature for identification were collected at Laysan Island.

LEODICIDAE

Leodice bilobata Treadwell.

Eunice bilobata Treadwell, 1906, pp. 1168 and 1169, figs. 47 and 48.

One specimen, doubtfully identified as of this species, collected at Prince of Wales Island.

Leodice dubia Woodward.

Eunice dubia Woodward, 1907, pp. 11 and 12, pl. 1, figs. 4 and 5.

Lysidice fusca Treadwell.

Lysidice fusca Treadwell, pp. 154 and 155, text figs. 42 to 44, pl. 6, figs. 7 to 13.

Collected at Johnston Island. Fragments were also taken at Laysan and

Fragments of a Leodice were taken at Laysan Island, others at Palmyra and at Johnston islands, fragments of a Lumbrinereis also were dredged off Laysan Island in 200 fathoms, but were all too incomplete for identification.

PHYLLODOCIDAE

Phyllodoce stigmata new species.

Two specimens collected in "tow off Johnston Island." The larger one I have designated as the type, and is 48 mm. in length with approximately 250 somites. The other is much smaller. Possibly neither is mature.

The prostomium of the type (fig. 11, *a*) is cordate in outline, with on either side a slight bulging opposite the eye. The antennae are short and approximately equal in size. The eyes are large and show no trace of lenses. The protruded pharynx is about six times as long as the prostomium, its basal portion being of somewhat greater diameter than the terminal. This basal portion is studded with disc-shaped papillae whose outer

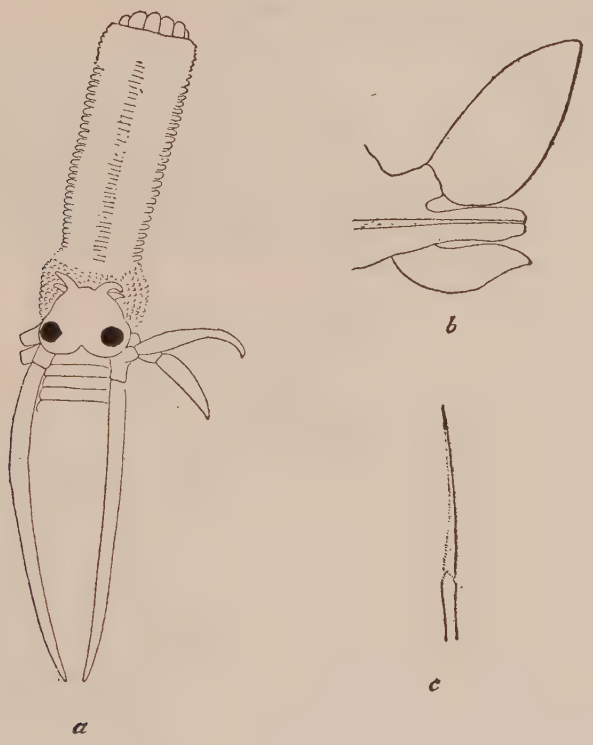

FIGURE 11. *Phyllodoce stigmata,* new species: *a,* anterior end, X 45; *b,* 24th parapodium, X 45; *c,* seta, X 250.

margins are colored darker than the rest of their surfaces. The terminal portion of the proboscis is about four times as long as the basal, and at its base is decidedly narrower than the latter. Toward the apex it becomes wider, but is never quite as wide as the basal section. There are seven longitudinal rows of papillae, one in the dorsal median line, and three latero-ventrally on either side. At the apex of the pharynx is a ring of 18 rounded, fleshy papillae.

Of the tentacular cirri, the posterior dorsal one is the longest and reaches to somite 16. In the type the ventral one of this pair is lost. The cirri of the first pair are hardly more than one-eighth as long as the dorsal second ones and are approximately equal in size, the ventral one being slightly the wider. In the smaller specimen the basal cirrus of the second pair is present. In shape, like the cirri of the first pair, it is about twice as long.

The first few body somites are approximately of the same width as the prostomium, but a slight increase in diameter appears throughout the middle of the body, narrowing

very decidedly at the posterior end. The only traces of color, aside from the outer margins of the proboscis papillae mentioned above, are on the dorsal surfaces of the somites in the posterior quarter of the body. On either side of the dorso-lateral surfaces between the bases of successive dorsal cirrophores is a dark brown or black line extending in an antero-posterior direction, and thrown into peculiar folds which are the same in all somites where the line occurs. It appears to follow the margin of a series of small foldings or lobes. Anteriorly the parapodial length is nearly equal to the body width, while posteriorly it is greater than that.

The parapodia (fig. 11, *b*) have the usual form of a single setal lobe with one acicula. The relatively large dorsal cirri are carried on a stout cirrophore. In this preserved material they are carried almost upright instead of folded over the back. The ventral cirrus extends about as far as the apex of the setal lobe, and has a broad base of attachment. This form of parapodium is continued throughout the body. The setae (fig. 11, *c*) are all alike, compound, the apex of the basal portion finely toothed and very fine teeth occurring on the convex side of the slender gently curved terminal portion. These terminal joints vary slightly in length in different parts of the seta bundle.

The type is in the Bishop Museum.

CIRRATULIDAE

Cirratulus sp.?

Two specimens were collected at Johnston Island and one from Lisiansky, all very poorly preserved and incomplete. The body is colored a dark yellowish brown with numerous black spots scattered over the surface. The tentacles are dirty gray in tint, with transverse black bands at regular intervals. The gills are thicker and heavier than the tentacles, dark brown in color but with uncolored tips. The tentacles form a dense tuft on what is apparently somite 7, but the anterior somites are indistinct so that this count may be inaccurate. In general characteristics these show very great resemblances to *C. nigromaculata* Treadwell (4, p. 204, fig. 66) so that it seems not improbable that they are of this species. Owing to poor preservation it is not possible to determine this point with accuracy and I have thought it best merely to leave it undescribed.

ALCIOPIDAE

Vanadis minuta Treadwell.

Vanadis minuta Treadwell 1906, pp. 1158 and 1159, figs. 25 to 28.

A few fragments taken in tow net off Wake Island. Only two anterior ends were present. One of these agrees closely with my original description. In the other the bulbous enlargement on the fourth somite, illustrated in figure 25 of the above paper, did not appear. It seems certain however, that these are both of the same species.

TEREBELLIDAE

Terebella sp.

A fragment from Wake Island, too badly injured for identification.

SERPULIDAE

Pomatoceros strigiceps Morch.

Pomatocerus strigiceps Morch. McIntosh, 1885, pp. 520 to 522, pl. 55, figs. 3 and 4, pl. 31a, figs. 26 to 28.

These were identified from McIntosh's description. In the taxonomy of this species the form of the operculum is of great importance and these were lost in both specimens, thus the identification was more difficult. The general form of the body and the structure of the setae correspond exactly with McIntosh's description, but I was unable to find any of the pigment which he mentions.

Two specimens were collected from Wake Island.

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FORAMINIFERA

BY

JOSEPH AUGUSTINE CUSHMAN

INTRODUCTION

The material collected by the Tanager Expedition during 1923 covered a most interesting region, that from Hawaii northwestward to Ocean Island and including to the south Johnston Island. Except in the region of Hawaii, very little is known about this area from the point of view of the foraminifera. The "Challenger" took samples off the coral reefs of Honolulu in 40 fathoms. Bagg in 1908 recorded many species from soundings made by the "Albatross" in the general region of the Hawaiian islands. Most of these stations, however, were in comparatively deep water, and represented Pacific conditions rather than localized species. In my own work on the North Pacific I had material of the "Nero" soundings in the exploration for the cable line between Honolulu and Midway Island. These again for the most part were from comparatively deep water, although some of them from about Midway Island and Oahu were in shallower water. In 1907 Rhumbler published a paper, part of which was based on very shallow-water collections from Laysan Island. Outside of these records practically nothing is known from the area. It is, therefore, with all the more interest that these collections of the Tanager Expedition have been studied. Unfortunately very many of the samples were extremely small in amount, being taken with soap from the soundings of the sounding lead. Others, however, collected from shallow depths in the reefs, give much better material for study. Many of the species, represented by single, much worn, or fragmentary specimens, serve to indicate the presence of the species. Larger samples undoubtedly would have very greatly increased the recorded fauna.

It is not only the presence of numerous species that is interesting but also the absence of many of the genera which are typically Indo-Pacific. They apparently do not range so far to the northeast. Among these are such species as *Planorbulina larvata,* which is very common in many parts of the Indo-Pacific. The genus Operculina seems to be entirely wanting in the area, although Heterostegina is abundant. *Baculogypsina sphaerulatus* does not occur, and usually has a more southern distribution. There are no species of Calcarina, although the genus is well represented in the Philippines and southeastward. There is sufficient material so that the absence of

these genera is not accidental, and probably represents a dropping out of these constituents of the general Indo-Pacific fauna in the Hawaiian region.

I have failed to find some of the species described by Rhumbler from Laysan, which have not since been recorded elsewhere, and which it was hoped might be rediscovered in the Tanager material. Most of his species, however, recorded from Laysan, are in the Tanager collections.

In order to simplify the synonymy and yet give available references, especially to Pacific localities, I have limited here the synonymy to the original reference and to a late paper on Pacific foraminifera. Wherever possible this second reference is to my own paper recently published on the foraminifera of Samoa.[16] That paper has very full references for these species. Where species were not recorded in that paper I have used the latest available work for this general region. Something of the distribution in related areas is also given, although I hope later to make these more nearly complete as the collecting about the Hawaiian group is carried on. It has not seemed necessary to illustrate any of these species as they are rather well illustrated in the references which I have given. A list of the stations and data is given, and numbers, assigned to these for simplifying the records, as follows.

STATIONS AND DATA

STA. NO.

1. Bottom sample, 40 fathoms, west of island of Kaula, July 1, 1923.
2. Bottom samples off Nihoa Island, south and west, 17 to 25 fathoms, May 27, 1923.
3. Bottom samples off Necker Island, in 15 to 20 fathoms.
4. Bottom samples, southeast of Necker Island, in 18 to 20 fathoms.
5. Bottom samples, 15 miles west of Gardner Island, in 29+ fathoms, May 21, 1923.
6. From 18 to 100 fathoms, 10 miles west of Gardner Island, May 22, 1923.
7. Dowsett Reef, 25 fathoms.
8. " " 39 "
9. " " 42 "
10. " " 19 "
11. " " 18 "
12. " " 26 "
13. " " 21 "
14. " " 20 "
15. " " 31 "
16. Laysan Island Reef, less than one fathom, April, 1923.
17. Off Lisiansky Island, 17 to 85 fathoms, May 19, 1923.
18. " " " 21 fathoms, May 15, 1923.
19. " " " 18 " May 15, 1923.
20. " " " 27 " May 15, 1923.
21. " " " 22 " May 15, 1923.
22. " " " 17 " May 15, 1923.
23. " " " 15 " May 15, 1923.
24. Pearl and Hermes Reef, Coll. Thaanum, April, 1923.

[16] Cushman, J. A., Foraminifera: Carnegie Inst. Wash., Publ. 342, 1924.

25. Off Midway Island, 45 fathoms, April 15, 1923.
26. " " " 38 " April 15, 1923.
27. " " " over 200 fathoms, April 15, 1923.
28. " " " 42 fathoms, April 15, 1923.
29. " " " 25 " April 15, 1923.
30. " " " 30 " April 15, 1923.
31. Midway Island, Coll. Thaanum, April, 1923. Washed from seaweed near shore.
32. Surface at Midway Island, April, 1923.
33. Ocean Island, Coll. Thaanum, April, 1923.
34. Johnston Island, shallow reef, 1/8 mile off shore.

TAXONOMY

Order FORAMINIFERA

Family TEXTULARIIDAE

Textularia folium Parker and Jones.

Textularia folium Parker and Jones, Philos. Roy. Soc. Trans., vol. 155, pp. 370, 420, pl. 18, fig. 19, 1865.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 12, pl. 7, fig. 2, 1924.

This is one of the typical species of shallow-water, coral-reef conditions in the general Indo-Pacific region. As a recent species it is recorded from shore sand, Melbourne (Parker and Jones); Mauritius, rare, from the intestine of *Maretia planulata* (Moebius); off East Moncoeur Island, Bass Strait, 38 fathoms; off Raine Island, Torres Strait, 155 fathoms; off Kandavu, Fiji, 255 fathoms; off Levuka, Fiji; Nares Harbor, Admiralty Islands, 17 fathoms; Honolulu coral-reefs, 40 fathoms (H. B. Brady); Mauritius and East Australia (Egger); from the lagoon at Funafuti; shore sands of Victoria (Chapman); shallow water off Laysan Island (Rhumbler); off the Hawaiian islands, 305 fathoms (Bagg); 249 and 271 fathoms (Cushman); a single specimen from the Kerimba Archipelago, 5 to 10 fathoms (Heron-Allen and Earland); and Lord Howe Island (Heron-Allen and Earland), a single specimen.

I also have specimens from the Philippines although not previously recorded. It seems to be characteristic of several of the areas from Hawaii to Midway Island, stations 1, 3, 6, and 16.

Textularia siphonifera H. B. Brady.

Textularia siphonifera H. B. Brady, Micr. Sci. Quart. Journ., vol. 21, p. 53, 1881; Rept. Voy. Challenger, Zoology, vol. 9, p. 362, pl. 42, figs. 25-29, 1884.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 13, pl. 2, fig. 5; pl. 4, figs. 4, 5, 1924.

This species has a somewhat different range from *T. folium*. It is only known in the Indo-Pacific, but was not recorded by Heron-Allen and Earland from the Kerimba Archipelago, which, considering the richness of their material, probably means its absence in that region. There are several records for it off Hawaii and as far west as the Gulf of Suez, north to

Blake Reef, Southern Japan, and southward to Australia. It occurs at stations 1, 2, 4, 14, 17, 18, 19, 23, 24, 25, 27, 29, 31, and 33.

Textularia rugosa (Reuss).

Plecanium rugosum Reuss, Sitz. Akad. Wiss. Wien, vol. 59, p. 453, pl. 1, figs. 3*a*, *b*, 1869.

Textularia rugosa H. B. Brady, Rept. Voy. Challenger, Zoology, vol. 9, p. 363, pl. 42, figs. 23, 24, 1884.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 14, pl. 3, fig. 2, 1924.

This species is very common in many parts of the Indo-Pacific, especially in the Philippine region. It occurs sparingly also in the tropical western Atlantic, but is in its well-developed form a typically Indo-Pacific species. Specimens were rare, however, in the Tanager collections, single, somewhat worn specimens occurring at stations 18 and 25.

Textularia flintii Cushman.

Textularia agglutinans Flint (in part), Rep. U. S. Nat. Mus., p. 284, pl. 29, fig. 4 (in part), 1897 (1899), (not *T. agglutinans* d'Orbigny).

Textularia rugosa Bagg, Proc. U. S. Nat. Mus., vol. 34, p. 131, 1908, [not *T. rugosa* (Reuss)].

Textularia flintii Cushman, U. S. Nat. Mus., Bull. 71, pt. 2, p. 21, fig. 36*a*, *b*, (in text), 1911; Bull. 100, vol. 4, p. 113, pl. 22, fig. 4, 1921.

There are single specimens from two stations, which seem to be this species. *Textularia rugosa* recorded by Bagg from off the Hawaiian islands is this species. I also have recorded it from off the Hawaiian islands and westward to the Philippines. It occurs usually, however, in deeper water than stations 3 and 27, occupied by the Tanager Expedition. It may be significant that one of these stations is in 200 fathoms off Midway Island.

Textularia foliacea Heron-Allen and Earland.

Textularia foliacea Heron-Allen and Earland, Zool. Soc., London, Trans., vol. 20, p. 628, pl. 47, figs. 17-20, 1915.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 14, pl. 2, figs. 2-4; pl. 3, fig. 1, 1924.

Heron-Allen and Earland originally described this species from the Kerimba Archipelago, and at the same time recorded it from the following Pacific localities: Timor Sea, Java, 50 fathoms; off Vavau, South Pacific, 16 fathoms; from off Fiji and "Coral Reef, Australia," 17 fathoms. I have recorded it from seven stations off the Philippines, the depths ranging from 20 to 494 fathoms, and also from Samoa, where it occurred at nearly all of the stations. The only specimen in the Tanager collections which can be referred to this species is from station 8, Dowsett Reef, in 39 fathoms. This is not typical, and may be a young specimen of this species.

Textularia rhomboidalis Millett.

Textularia rhomboidalis Millett, Roy. Micr. Soc. Journ., p. 559, pl. 7, fig. 4, 1899.—Cushman, U. S. Nat. Mus., Bull. 71, pt. 2, p. 16, text figs. *25a, b,* 1911.

There is a single specimen from station 12, Dowsett Reef, 26 fathoms, which is identical with the species described by Millett from the Malay region. I already have recorded this species from "Nero" station 2042, in 55 fathoms, near the Hawaiian islands, and Heron-Allen and Earland have recorded it as abundant from Lord Howe Island and also from the Kerimba Archipelago. It is therefore apparently widely distributed in the Indo-Pacific.

Bolivina limbata H. B. Brady.

Bolivina limbata H. B. Brady, Micr. Sci. Quart. Journ., vol. 21, p. 57, 1881.—Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 135, pl. 19, fig. 5, 1921.

Single specimens which may be referred to this species occurred at stations 3 and 16. It is known from numerous points in the Indo-Pacific.

Bolivina limbata H. B. Brady, var. **costulata** Cushman.

Bolivina limbata H. B. Brady, var. *costulata* Cushman, Carnegie Inst. Wash., Publ. 311, p. 26, pl. 3, fig. 8, 1922; U. S. Nat. Mus., Bull. 104, pt. 3, p. 37, 1924; Carnegie Inst. Wash., Publ. 342, p. 19, pl. 5, figs. 2, 3, 6, 1924.

This variety differs from the typical form mainly in the addition of longitudinal costae, usually few in number and near the base of the test. There is a single specimen of this species from station 1, west of Kauai, in 40 fathoms. It is probably widely distributed in the tropical Indo-Pacific from the Kerimba Archipelago on the west to Funafuti and Samoa. It also occurs in the western tropical Atlantic.

Verneuilina spinulosa Reuss.

Verneuilina spinulosa Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, p. 374, pl. 47, fig. 12, 1850.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 21, 1924.

This species, which is characteristic of warm, shallow water in tropical regions, is one of the most abundant in the Tanager collections, occurring at most of the stations from which any amount of material was obtained as follows: stations 2, 3, 4, 5, 6, 7, 8, 9, 15, 16, 17, 25, 27, 28, 31, 33, and 34. It is widely distributed under such conditions throughout the Indo-Pacific, and also in the western Atlantic.

Gaudryina triangularis Cushman, var. **angulata** Cushman.

Gaudryina triangularis Cushman, var. *angulata* Cushman, Carnegie Inst. Wash., Publ. 342, p. 22, 1924.

This variety, which was described from Samoa, has been found in the Tanager collections at stations 17, 27, 31 and 33. It is probably widely

distributed in the Indo-Pacific; apparently recorded from the Kerimba Archipelago by Heron-Allen and Earland.[16]

Pavonina flabelliformis d'Orbigny.

Pavonina flabelliformis d'Orbigny, Ann. Sci. Nat., vol. 7, p. 260, pl. 10, figs. 10, 11, 1826.—Cushman, U. S. Nat. Mus., Bull. 71, pt. 2, p. 30, 1911.

This species, which is typically Indo-Pacific, has occurred as a single broken specimen from station 15, Dowsett Reef, 31 fathoms. It was recorded from off the coral reefs of Honolulu, 40 fathoms, by Brady; from "Albatross" station D4174, near the Hawaiian islands, in 735 to 865 fathoms, by Bagg. I had specimens from "Nero" station 2042, in 55 fathoms, near the Hawaiian islands, and station 201, in 1033 fathoms, near Midway Island. D'Orbigny's original material came from Madagascar, where it was rediscovered by Moebius. It is also recorded by Heron-Allen and Earland from the Kerimba Archipelago, and a single broken specimen from Lord Howe Island.

Family LAGENIDAE

Lagena sp. cf. **orbignyana** (Seguenza).

There is a single specimen from station 16, Laysan Island, which is very small, but many of its characteristics resemble the above species.

Cristellaria calcar (Linnaeus).

Nautilus calcar Linnaeus, Syst. Nat., ed. 12, p. 1162, no. 272, 1767; (Gmelin's) ed. 13, p. 3370, no. 2, 1788.

Cristellaria calcar Parker and Jones, Ann. Mag. Nat. Hist., ser. 2, vol. 19, p. 289, pl. 10, figs. 10-12, 1857.—Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 231, pl. 45, figs. *2a, b,* 1921.

There is a single specimen, which belongs to the form of this species figured by Brady, and which I have copied (U. S. Nat. Mus. Bull. 71, pt. 3, pl. 32, fig. 4). The spines, however, are almost obsolete, and are marked by very short projections, one on each chamber. It is from station 27, off Midway Island, 200 fathoms.

Cristellaria helicina Cushman.

Cristellaria helicina Cushman, U. S. Nat. Mus. Proc., vol. 51, p. 660, 1917; U. S. Nat. Mus., Bull. 100, vol. 4, p. 250, pl. 51, figs. *4a, b,* 1921.

There is a single specimen of this species from station 27, off Midway Island, 200 fathoms. I originally described the species from the Philippines, where it occurs at numerous stations from 118 to 540 fathoms. It did not occur in any of the shallow-water material.

[16]Heron-Allen, E. and Earland A., Foraminifera of the Kerimba Archipelago: Zool. Soc. London, Trans., vol. 20, p. 635, 1915.

Cristellaria orbicularis (d'Orbigny), var. **papillata** Cushman.

Cristellaria orbicularis (d'Orbigny), var. *papillata* Cushman, U. S. Nat. Mus. Proc., vol. 51, p. 657, 1917; U. S. Nat. Mus., Bull. 100, vol. 4, p. 226, pl. 44, fig. 2, 1921.

A single specimen of this variety was obtained from station 27, off Midway Island, 200 fathoms. It was originally described from the Philippines.

Cristellaria rotulata (Lamarck).

Lenticulites rotulata Lamarck, Ann. Mus., vol. 5, p. 188, no. 3, 1804; vol. 8, pl. 62, fig. 11, 1806.

Cristellaria rotulata H. B. Brady, Rept. Voy. Challenger, Zoology, vol. 9, p. 547, pl. 69, figs. 13*a*, *b*, 1884.—Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 223, 1921.

There is a single, very small specimen from station 34, Johnston Island, which has most of the characters of this species, and is evidently an immature specimen.

Trifarina bradyi Cushman.

Vaginulina tricarinata d'Orbigny, Ann. Sci. Nat., vol. 7, p. 258, no. 4, Modeles, no. 4, 1826.

Rhabdogonium tricarinatum H. B. Brady, Rept. Voy. Challenger, Zoology, vol. 9, p. 525, pl. 67, figs. 1-3, 1884.

Triplasia tricarinata Cushman, U. S. Nat. Mus., Bull. 71, pt. 3, p. 62, pl. 39, fig. 2, 1913.

Trifarina bradyi Cushman, U. S. Nat. Mus., Bull. 104, pt. 4, p. 99, pl. 22, figs. 3-9, 1923; Carnegie Inst. Wash., Publ. 342, p. 27, pl. 7, fig. 5, 1924.

The only record for this species from the Tanager material is from station 6, ten miles west of Gardner Island. The specimen is very typical. Bagg found the species to be very abundant at several "Albatross" stations from about the Hawaiian Islands, at depths from 104 to 1544 fathoms. I also had it from the region of the Hawaiian islands, but at considerable depths. It is not a species of shallow water, and, therefore, would not be expected from such material as that obtained by the Tanager Expedition. At Samoa it was obtained only from the deepest station, 50 fathoms.

Uvigerina pacifica new sp.

Uvigerina selseyensis Cushman (not Heron-Allen and Earland), U. S. Nat. Mus., Bull. 71, pt. 3, p. 93, pl. 42, fig. 5, 1913; Bull. 100, vol. 4, p. 272, 1921.—Heron-Allen and Earland, Zool. Soc. London, Trans., vol. 20, p. 675, 1915; Linn. Soc. Zool., Journ. vol. 35, p. 626, pl. 36, figs. 30, 31, 1924.

Test somewhat fusiform, broadest above the middle, about twice as long as broad, triangular in transverse section; chambers numerous, distinct, the proximal margin with distinct re-entrant; sutures distinct, somewhat depressed; surface somewhat roughened, the ornamentation usually taking the form of an obscure, longitudinal striation; apertural end with a short neck and phialine lip.

Length .45 mm. or less.

Type specimen from station 2, off Nihoa Island, 17 to 25 fathoms; also from station 9.

This species, which has been referred to *Uvigerina selseyensis,* seems to be rather widely distributed in the Indo-Pacific region. It is recorded by Heron-Allen and Earland from the Kerimba Archipelago and from Lord Howe Island. I have had the species from "Albatross" station H2923, in 392 fathoms, off the Hawaiian islands, and also from a single station in the Philippines. This would, therefore, indicate that it is to be looked for elsewhere in the Indo-Pacific. It somewhat resembles the species that I have described from the Philippines as *Uvigerina scrobiculata.* . . . . but a comparison of the types shows that this Philippine species is very much larger, has a much heavier test, and is very distinct from *U. pacifica.*[17]

Siphogenerina raphanus (Parker and Jones).

Uvigerina (*Sagrina*) *raphanus* Parker and Jones, Philos. Trans., vol. 155, p. 364, pl. 18, figs. 16, 17, 1865.

Siphogenerina raphanus Cushman, U. S. Nat. Mus., Bull. 71, pt. 3, p. 108, pl. 46, figs. 1-5, 1913; Carnegie Inst. Wash., Publ. 342, p. 28, pl. 8, figs. 1, 2, 1924.

There is a single specimen of this typically Indo-Pacific species from station 24, Pearl and Hermes Reef. It is known from very widely scattered stations in the Indo-Pacific, and also is found in the western tropical Atlantic. It is surprising not to have found this more widely distributed in the Tanager collections.

Family GLOBIGERINIDAE

Globigerina bulloides d'Orbigny.

This very widely distributed species occurs at stations 1, 2, 3, 6, 8, 9, 17, and 34, but never in any considerable numbers.

Globigerina triloba Reuss.

This species, sometimes considered a variety of *G. bulloides,* occurs at the deep station, 200 fathoms, off Midway Island, station 27, and a single specimen from station 20, off Laysan.

Globigerina dubia Egger.

A single specimen from station 34, Johnston Island, may be referred to this species.

Globigerina rubra d'Orbigny.

Specimens of this species are very rare, and, as in the case of most other Pacific specimens, they fail to have the color which is characteristic of typical Atlantic specimens. This occurs at stations 3, 8, and 27.

[17] Cushman, J. A., Foraminifera of the Philippine and Adjacent Seas: U. S. Nat. Mus., Bull. 100, vol. 4, p. 276, text figs. 100*a*, *b*, 1921.

Globigerina inflata d'Orbigny.

There is a single specimen of this pelagic species from station 27, 200 fathoms, off Midway Island.

Globigerina conglobata H. B. Brady.

The only record for this species is at 45 fathoms, off Midway Island, station 25.

Sphaeroidina dehiscens Parker and Jones.

A single broken specimen from 200 fathoms, off Midway Island, gives the only record in the Tanager collections for this species, station 27.

Family ROTALIIDAE

Spirillina limbata H. B. Brady, var. *tuberculo-limbata* Chapman.

Spirillina tuberculo-limbata Chapman, Linn. Soc. London, Journ. Zoology, vol. 28, p. 11, pl. 1, figs. 8*a-c*, 1900.

Spirillina limbata H. B. Brady, var. *tuberculo-limbata* Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 302, 1921; Carnegie Inst. Wash., Publ. 342, p. 31, pl. 9, figs. 4, 5, 1924.

This variety has occurred in the Tanager collections at stations 3, 17, 25, and 33. Chapman originally described this form from Funafuti, where it occurred at numerous stations, and I have had it from off the Hawaiian islands previously, at *Nero* station 2039, in 24 fathoms. I have also had it from off Guam and from the Philippines. It is evidently a characteristic variety in the Indo-Pacific, probably with a wide distribution.

Spirillina decorata H. B. Brady.

Spirillina decorata H. B. Brady, Rept. Voy. Challenger, Zoology, vol. 9, p. 633, pl. 85, figs. 22-25, 1884.—Cushman, U. S. Nat. Mus., Bull. 71, pt. 5, p. 7, pl. 5, figs. 1, 2, text fig. 7, 1915.

This species occurred in material from the Tanager Expedition at station 25, off Midway Island, and station 17, off Lisiansky. Brady's original description of this species included deep-water material from the Atlantic, and also three stations in the South Pacific. This is a rather unusual distribution, and may mean that more than one species is involved in the range given. It seems to be widely distributed in the Indo-Pacific. Brady's Pacific stations were off Raine Island, 155 fathoms, off Booby Island, 6 fathoms, and off Kandavu, Fiji, 610 fathoms. There are numerous other records for the Pacific. Egger had it from Mauritius and from West Australia; Millett from Malay Archipelago; Dakin off Ceylon; Rhumbler from Laysan; Chapman from off New Zealand; Heron-Allen and Earland record it from the Kerimba Archipelago, from Lord Howe Island, and from some of the British Antarctic Expedition stations; Mestayer had it

from off New Zealand, and I found it in material from the same region; Sidebottom records it from the east coast of Australia, at 465 fathoms. This makes a very typical Indo-Pacific distribution.

Spirillina vivipara Ehrenberg.

Spirillina vivipara Ehrenberg, Akad. Wiss. Berlin, Abh., p. 442, pl. 3, fig. 41, 1841.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 30, pl. 9, figs. 1, 2, 1924.

There is a single small specimen taken at the surface off Midway Island, station 32. This is the only record in the Tanager collections. As in the case of the Samoan specimens, the very coarse perforations, which are typical of Atlantic specimens, are not well developed. This may, therefore, represent a different form from the Atlantic one.

Discorbis irregularis (Rhumbler).

Discorbina irregularis Rhumbler, Zool. Jahrb. Abt. Syst., vol. 24, p. 70, pl. 5, figs. 57, 58, 1906.—Cushman, U. S. Nat. Mus., Bull. 71, pt. 5, p. 22, pl. 13, figs. 2, 3, 1915.

Rhumbler described this peculiar, flattened, irregular species from the Chatham Islands. The only specimen I have had, which seems to belong here, is a single one from Ocean Island, station 33.

Discorbis lauriei (Heron-Allen and Earland).

Discorbina lauriei Heron-Allen and Earland, Linn. Soc. Zool. Journ., vol. 35, p. 633, pl. 36, figs. 50-52; pl. 37, figs. 53-55, 1924.

Heron-Allen and Earland recently described this species from Lord Howe Island in the South Pacific. Specimens which seem best referred to their species rather than to *D. tabernacularis* H. B. Brady were found in the Tanager collections at stations 2, 3, 6, 8, 15, 16, 17, 24, and 25. It is distinct from *D. orientalis*.

Discorbis orientalis new species.

Discorbina globularis Heron-Allen and Earland, Zool. Soc., Trans., London, vol. 20, p. 694, pl. 51, figs. 36-39, 1915.

Test subglobular, dorsal side much convex, ventral side flattened or concave in the center, umbilicate, test composed of about two to three coils, the last-formed one having usually four chambers; chambers distinct, inflated; sutures distinct but only slightly depressed; wall on the dorsal side evenly punctate, on the ventral side smooth, without definite punctae; the umbilical end of each chamber ending in a toothlike process, bluntly pointed; aperture an elongate, arched slit on the ventral side of the last-formed chamber. Diameter about 0.6 mm.

Specimens of this species were fairly common in the material from Ocean Island, station 33; also found at station 31. They are evidently the same as that referred to *D. globularis* and figured by Heron-Allen and Earland from the Kerimba Archipelago. These two records would seem to indicate that the species probably has a wide Indo-Pacific range.

Discorbis subbertheloti Cushman.

Discorbina bertheloti H. B. Brady (in part) (not d'Orbigny), Rep. Voy. Challenger, Zoology, vol. 9, p. 650, pl. 89, figs. 10 *a, b,* 1884.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 33, pl. 10, fig. 1, 1924.

From Dowsett Reef in 39 fathoms, station 8, there is a single specimen which seems to belong to this species which I have recently described from Samoa. It is apparently rather widely distributed, especially in the South Pacific and Australian regions, and perhaps also in the Indian Ocean.

Discorbis turbo (d'Orbigny).

Rotalia (Trochulina) turbo d'Orbigny, Ann. Sci. Nat., vol. 7, p. 274, no. 39; Modèles, no. 73, 1826.

Discorbina turbo Carpenter, Parker and Jones, Introd. Foram., p. 200, 1862.

Discorbis turbo Cushman, U. S. Nat. Mus., Bull. 71, pt. 5, p. 10, pl. 11, fig. 2, 1915.

This is a rather typical Indo-Pacific species from shallow water. It occurred at several stations in the Tanager material, from Nihoa to Ocean Island, stations 2, 6, 11, 15, 16, 24, 31, and 33.

Cymbalopora squammosa (d'Orbigny).

Rotalia squammosa d'Orbigny, Ann. Sci. Nat., vol. 7, p. 272, no. 8, 1826.

Rosalina squammosa d'Orbigny, Foraminifères in De la Sagra, Hist. Fis. Pol. Nat. Cuba, p. 91, pl. 3, figs. 12-14, 1839.

Rosalina poeyi d'Orbigny, Foraminifères, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, p. 62, pl. 3, figs. 18-20, 1939.

Cymbalopora squammosa Cushman, Carnegie Inst. Wash., Publ. 311, p. 41, pl. 6, figs. 4-6, 1922.

This high-spired form which d'Orbigny described from Cuba is apparently widely distributed in the Indo-Pacific, as well as in the western tropical Atlantic. It has occurred in the Tanager collections at stations 3, 6, 7, 16, 24, 25, 31, 33, and 34. Its distribution in the Indo-Pacific is, however, somewhat localized as no specimens of it were found in the Samoan collections. The name *squammosa* should be used instead of *C. poeyi* d'Orbigny, according to the rules of priority, *Rotalia squammosa* having been used by d'Orbigny for this form in 1826, while *C. poeyi* was not used until 1839.

Cymbalopora bradyi Cushman.

Cymbalopora poeyi (d'Orbigny), var. H. B. Brady, Rept. Voy. Challenger Zoology, vol. 9, p. 637, pl. 102, fig. 14, 1884.

Cymbalopora poeyi (d'Orbigny), var. *bradyi* Cushman, U. S. Nat. Mus., Bull. 71, pt. 5, p. 25, pl. 10, fig. 2; pl. 14, fig. 2, 1915; Bull. 100, vol. 4, p. 308, 1921.

Cymbalopora bradyi Cushman, Carnegie Inst. Wash., Publ. 342, p. 34, pl. 10, figs. 2-4, 1924.

This species which seems to be a valid one is also common in the Tanager collections, being found at stations 6, 24, 27, 31, 33, and 34. It is widely distributed in the Indo-Pacific and apparently typical of this area.

There are numerous records for it in the Indo-Pacific, mostly in shallow water about coral reefs.

Tretomphalus bulloides (d'Orbigny).

Rosalina bulloides d'Orbigny, Foraminifères in De la Sagra, Hist. Fis. Pol. Nat. Cuba, p. 104, pl. 3, figs. 2-5, 1839.

Tretomphalus bulloides Moebius, Beitr. Meeresfauna, Insel Mauritius, p. 98, pl. 10, figs. 6-9, 1880.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 36, pl. 11, figs. 1-3, 1924.

There are only two records, stations 16 and 32, from the Tanager collections for this species, which has a rather wide range, apparently occurring both in the Indo-Pacific and the western tropical Atlantic. It is one of the few pelagic species found about coral reefs.

Tretomphalus milletti (Heron-Allen and Earland).

Cymbalopora bulloides Millett (not d'Orbigny), Roy. Micr. Soc. Journ., p. 697, pl. 7, fig. 4, 1903.

Cymbalopora milletti Heron-Allen and Earland, Zool. Soc. Trans., London, vol. 20, p. 689, pl. 51, figs. 32-35, 1915.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 36, pl. 11, fig. 4, 1924.

This species originally figured by Millett from the Malay region and described by Heron-Allen and Earland from the Kerimba Archipelago has occurred at station 33 in the Tanager collections, off Ocean Island. It probably occurs widely distributed over the Indo-Pacific, being known from off Hawaii and off Fiji, and I found it in collections from Samoa.

Truncatulina lobatula (Walker and Jacob)?

Nautilus lobatulus Walker and Jacob, Adams Essays, Kanmacher's ed., p. 642, pl. 14, fig. 36, 1798.

Truncatulina lobatula d'Orbigny, Foraminifères in Barker, Webb, and Berthelot, Hist. Nat. Isles Canaries, vol. 2, pt. 2, p. 134, pl. 2, figs. 22-24, 1839.—Cushman, U. S. Nat. Mus., Bull. 71, pt. 5, p. 31, pl. 15, fig. 1, 1911.

There are numerous specimens which are somewhat questionably referred to this species. They lack some of the characters of typical Atlantic specimens of *T. lobatula,* and are as a rule more regular in form. I have found them at stations 16, 24, and 33 of the Tanager collections.

Truncatulina mayori Cushman.

Truncatulina mayori Cushman, Carnegie Inst. Wash., Publ. 342, p. 39, pl. 12, figs. 3, 4, 1924.

Specimens of this distinct species occurred at station 21, off Lisiansky Island and station 27, off Midway Island, 200 fathoms or more. The original specimens of this species came from Samoa, so it is probably to be looked for in the general Indo-Pacific region.

Truncatulina cora d'Orbigny.

Rosalina cora d'Orbigny, Foraminifères Voy. Amér. Mérid., vol. 5, pt. 5, p. 45, pl. 6, figs. 19-21, 1839.

Truncatulina cora Cushman, Carnegie Inst. Wash., vol. 17, p. 48, pl. 7, figs. 3-5, 1922.

A few specimens in the Tanager collections are very close to, if not identical with, this species of d'Orbigny, found at stations 3, 15, 16, and 30. His original type specimens were from the coast of Peru. I have had material from the Tortugas region, in the Gulf of Mexico, which seems identical with this. Its extension to the Hawaiian region would indicate that it may be widely distributed in the Pacific.

Anomalina glabrata Cushman.

Anomalina glabrata Cushman, Carnegie Inst. Wash., Publ. 342, p. 39, pl. 12, figs. 5-7, 1924.

A single specimen from Dowsett Reef, 18 fathoms, station 11, is the same as the species I have recently described from Samoa.

Anomalina ammonoides Reuss?

There are single specimens from 10 miles west of Gardner Island, station 6, and off Necker Island, station 3, which are close to the form figured under this name by Brady in the Challenger report. Whether this is identical with Reuss' species seems rather questionable.

Siphonina echinata H. B. Brady.

Planorbulina echinata H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, p. 283, pl. 8, fig. 31, 1879.

Truncatulina echinata H. B. Brady, Rep. Voy. Challenger, Zoology, vol. 9, p. 670, pl. 94, figs. 9-14, 1884.

Siphonina echinata Cushman, Carnegie Inst. Wash., Publ. 342, p. 40, pl. 12, fig. 8, 1924.

Very typical specimens of this characteristic Indo-Pacific species occurred at station 7, off Dowsett Reef, 25 fathoms, and station 33, off Ocean Island. It is known from as far west as the Kerimba Archipelago, as far east as reefs off Honolulu, and is generally distributed through the islands of the Indian Ocean and South Pacific. I, however, did not find it in the Philippine region nor was it reported from there by Brady.

Pulvinulina repanda (Fichtel and Moll).

Nautilus repandus Fichtel and Moll, Test. Micr., p. 35, pl. 3, figs. *a-d*, 1798.

Pulvinulina repanda Parker and Jones, in Carpenter, Parker and Jones, Introd. Foram., p. 311, 1862.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 42, pl. 13, figs. 9, 10, 1924.

This is a characteristic species of shallow-water, coral-reef areas, especially in the Indo-Pacific. Many of the Tanager specimens are of large

size for this species, which I found in the collections at stations 1, 2, 3, 6, 21, 24, 25, 27, and 33.

Pulvinulina truncatulinoides d'Orbigny.

Rotalina truncatulinoides d'Orbigny, Foraminifères in Barker, Webb, and Berthelot, Hist. Nat. Isles Canaries, vol. 2, pt. 2, p. 132, pl. 2, figs. 25-27, 1839.

Pulvinulina truncatulinoides Parker and Jones, Philos. Trans., vol. 155, p. 398, pl. 16, figs. 41-43, 1865.—Cushman, U. S. Nat. Mus., Bull. 71, pt. 5, p. 59, pl. 23, fig. 4, text fig. 57, 1915.

This pelagic species is of very wide distribution, and occurred only at station 27, off Midway Island.

Pulvinulina concentrica Parker and Jones.

Pulvinulina concentrica (Parker and Jones, MS.) H. B. Brady, Trans. Linn. Soc., London, vol. 24, p. 470, pl. 48, fig. 14, 1864.—Cushman, U. S. Nat. Mus., Bull. 71, pt. 5, p. 51, pl. 28, fig. 4, 1915.

This is apparently the first record for this region. It occurred at the deep-water station 27, 200 fathoms or more, off Midway Island. From the North Pacific it is known from several stations in the Philippines and from two stations in comparatively shallow water off Japan. There are numerous records for it in the South Pacific.

Pulvinulina berthelotiana d'Orbigny, var. **subornata** Cushman.

Pulvinulina berthelotiana d'Orbigny, var. *subornata* Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 333, pl. 70, fig. 1, 1921.

This variety originally described from the China Sea, off Hongkong, and recorded from several stations in the Philippine region, has occurred at station 27, off Midway Island, 200 fathoms or more, but nowhere else in the Tanager material.

Pulvinulina menardii d'Orbigny.

Rotalia menardii d'Orbigny, Ann. Sci. Nat., vol. 7, p. 273, no. 26; Modèles, no. 10, 1826.

Pulvinulina menardii Owen, Linn. Soc. Journ., London, vol. 9, p. 148, pl. 5, fig. 6, 1867.—Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 333, pl. 66, figs. 1*a-c*, 1921.

This species, which is pelagic and of very wide distribution in all the oceans, has occurred at a number of the Tanager stations, usually, however, in very few numbers; stations 3, 6, 26, 27, and 28.

Pulvinulina elegans (d'Orbigny).

Rotalia (*Turbinulina*) *elegans* d'Orbigny, Ann. Sci. Nat., vol. 7, p. 276, no. 54, 1826.

Pulvinulina elegans Jones and Parker, Geologist, vol. 7, p. 88, 1864.—Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 342, 1921.

This is a very abundant species in the Philippine region, but occurred at only two stations in the Tanager material; 10 miles off Gardner Island, station 6, and at 200 fathoms, off Midway Island, station 27.

Gypsina vesicularis (Parker and Jones).

Orbitolina vesicularis Parker and Jones, . . . Ann. Mag. Nat. Hist., ser. 3, vol. 6, p. 31, no. 5, 1860.

Gypsina vesicularis Carter, Ann. Mag. Nat. Hist., ser. 4, vol. 19, p. 173, 1877.—Brady, Rep. Voy. Challenger, Zool., vol. 9, p. 718, pl. 101, figs. 9-12, 1884.—Heron-Allen and Earland, Zool. Soc. Trans., London, vol. 20, p. 726, 1915.

Very rare specimens from Dowsett Reef, 39 fathoms, station 8, may be referred to the typical form of this species. It is known from the Kerimba Archipelago, from Funafuti, and elsewhere. In the Tanager collections it is usually represented by variety *squamiformis*.

Gypsina vesicularis (Parker and Jones), var. **squamiformis** Chapman.

Gypsina vesicularis (Parker and Jones), var. *squamiformis* Chapman, Journ. Linn. Soc. Zool., vol. 28, p. 200, pl. 19, figs. 15 *a*, *b*, 1900; p. 407, 1902.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 46, pl. 15, fig. 4, 1924.

At Laysan, station 16, this variety is common, and a rare specimen occurred at station 30, off Midway Island, 30 fathoms. Chapman originally described this species from the Lagoon at Funafuti, Heron-Allen and Earland record it from the Kerimba Archipelago, off southeastern Africa, and my own record from Samoa gives it a wide distribution in the Indo-Pacific.

Gypsina globulus Reuss.

Ceriopora globulus Reuss, Haidinger's Nat. Abh., vol. 2, p. 33, pl. 5, fig. 7, 1847.

Gypsina globulus H. B. Brady, Rep. Voy. Challenger, Zoology, vol. 9, p. 717, pl. 101, fig. 8, 1884.—Cushman, Carnegie Inst., Wash., Publ. 342, p. 45, 1924.

The only specimen of this species occurred at station 33, Ocean Island. It is characteristic of coral-reef regions in the Indo-Pacific, and there are a few records for it elsewhere.

Polytrema miniacea (Gmelin).

Millepora miniacea Linnaeus, Syst. Nat., ed. 13 (Gmelin's), vol. 1, pt. 6, p. 3784, no. 6, 1788.

Polytrema miniaceum Blainville, Dict. Sci. Nat., vol. 42, Atlas, Zooph., vol. 1, p. 17, 1826.—H. B. Brady, Rep. Voy. Challenger, Zoology, vol. 9, p. 721, pl. 100, figs. 5-9, 1884.—Cushman, Carnegie Inst., Wash., Publ. 342, p. 46, 1924.

Several fragments of this species were obtained off Ocean Island, station 33, but it seems to be wanting in the other Tanager collections. As it is an attached species, it would not be likely to be found in any amount in such bottom samples as were collected by the Tanager Expedition.

Family NUMMULITIDAE

Polystomella crispa (Linnaeus).

Nautilus crispus Linnaeus, Syst. Nat., ed. 12, p. 1162, 1767.

Polystomella crispa Lamarck, Anim. sans Vert., vol. 7, p. 625, no. 1, 1822.—H. B. Brady, Rep. Voy. Challenger, Zoology, vol. 9, p. 736, pl. 110, figs. 6, 7, 1884.—Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 368, 1921.

The only specimen of Polystomella found at all in the material dredged by the Tanager Expedition is a single one of this species from Pearl and Hermes Reef, station 24. It is rather surprising that there are no other specimens of this genus, as it is usually characteristic of Indo-Pacific collections.

Amphistegina lessonii d'Orbigny.

Amphistegina lessonii d'Orbigny, Ann. Sci. Nat., vol. 7, p. 304, no. 3, pl. 17, figs. 1-4, 1826.—H. B. Brady, Rep. Voy. Challenger, Zoology, vol. 9, p. 740, pl. 111, fig. 1, 1884.—Cushman, U. S. Nat. Mus. Bull. 100, vol. 4, p. 370, 1921.

The somewhat flattened, biconvex form, which is referred to the typical form of this species, occurred in very few numbers, at stations 1, 2, 17, 18, and 29, while the species, *A. madagascarensis* and *A. radiata,* were very abundant. It may be noted in this connection that at Samoa only these two species were recorded.

Amphistegina madagascarensis d'Orbigny.

Amphistegina madagascarensis d'Orbigny, Ann. Sci. Nat., vol. 7, p. 305, no. 5, 1826.

Amphistegina lessonii d'Orbigny, var. *madagascarensis* Heron-Allen and Earland, Zool. Soc. London, Trans., vol. 20, p. 736, 1915.

Amphistegina madagascarensis Cushman, Carnegie Inst. Wash., Publ. 342, p. 49, pl. 17, fig. 3, 1924.

This is one of the more common species in the Tanager Expedition collections occurring at stations 1, 2, 3, 4, 5, 6, 7, 16, 17, 18, 24, 25, 26, 33, and 34, often in considerable numbers. It is apparently an Indo-Pacific species, originally described by d'Orbigny from the coast of Madagascar.

Amphistegina radiata (Fichtel and Moll).

Nautilus radiatus Fichtel and Moll, Test. Micr., p. 58, pl. 8, figs. 8*a-d,* 1798.

Amphistegina radiata Chapman, Proc. Zool. Soc. London, pp. 45-47, pl. 1, figs. 8-10, 12, 1895.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 49, pl. 17, figs. 1, 2, 1924.

It is found at many of the stations: 1, 2, 3, 4, 5, 6, 7, 13, 16, 17, 18, 24, 26, 28, 29, 33, and 34. This is the dominating species. Some of these are much larger than the usual run of specimens, those from Pearl and Hermes Reef being nearly globular and measuring over 2 mm. in diameter.

Heterostegina suborbicularis d'Orbigny.

Heterostegina suborbicularis d'Orbigny, Ann. Sci. Nat., vol. 7, p. 305, 1826.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 51, 1924.

Well developed specimens of this species occur at stations 1, 2, 3, 4, 5, 10, 16, 17, 18, 24, and 33. It is very common in some parts of the Philippine area and probably is widely distributed in the Indo-Pacific.

Family MILIOLIDAE

Spiroloculina antillarum d'Orbigny.

Spiroloculina antillarum d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, Foraminifères, p. 166, pl. 9, figs. 3, 4, 1839.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 55, pl. 20, fig. 1, 1824.

Spiroloculina grata Terquem (?) and later authors.

There are numerous stations for this characteristic species of coral-reef areas, as follows: 6, 15, 16, 17, 24, 33, and 35.

Spiroloculina antillarum d'Orbigny, var. **angulata** Cushman.

Spiroloculina grata H. B. Brady (in part), Rep. Voy. Challenger, Zoology, vol. 9, pl. 10, figs. 22, 23, 1884.

Spiroloculina grata Terquem, var. *angulata* Cushman, U. S. Nat. Mus., Bull. 71, pt. 6, p. 36, pl. 7, fig. 5, 1917.

Spiroloculina antillarum d'Orbigny, var. *angulata* Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 408, pl. 81, figs. 5*a*, *b*, 1921.—Carnegie Inst. Wash., Publ. 342, p. 55, pl. 20, fig. 2, 1924.

This variety is less common in the Tanager collections than the typical form, occurring at stations 3, 6, 7, and 25.

Spiroloculina mayori Cushman.

Spiroloculina mayori Cushman, Carnegie Inst. Wash., Publ. 342, p. 56, pl. 20, figs. 5, 6, 1924.

A single specimen of this species, which I have recently described from Samoa, occurred at station 1, in 40 fathoms, west of Kaula.

Spiroloculina planissima (Lamarck), var. **samoaensis** Cushman.

Spiroloculina planissima (Lamarck), var. *samoaensis* Cushman, Carnegie Inst. Wash., Publ. 342, p. 58, pl. 21, figs. 9, 10, 1924.

There are single specimens from station 24, Pearl and Hermes Reef, and station 16, Laysan Island Reef, less than 1 fathom. These seem to be identical with this variety, which I have recently described from Samoa.

Vertebralina striata d'Orbigny.

Vertebralina striata d'Orbigny, Ann. Sci. Nat., vol. 7, p. 283, no. 1, 1826; Modèles, no. 81, 1826.—Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 414, 1921.

The only specimen is one from off Midway Island, 200 fathoms, station 27. Heron-Allen and Earland record it from numerous stations in their Kerimba Archipelago material, and it is recorded from numerous stations in

the Indo-Pacific. I found it, however, rare in the Philippines, but the only specimen from Samoa was like the specimens figured by Brady (Rep. Voy. Challenger, Zoology, vol. 9, 1884, pl. 12, figs. 15, 16). The specimen from Midway Island resembles this more than it does the Atlantic form described by d'Orbigny, and more material may show that the Pacific form is a distinct species.

Articulina sp.?

West of Kaula, 40 fathoms, station 1, are two specimens of this genus. They resemble specimens figured by Heron-Allen and Earland (Trans. Zool. Soc. London, vol. 20, 1915, p. 45, figs. 22-25) as *A. sagra.* These, however, do not agree at all well with *A. sagra* of d'Orbigny from the western Atlantic.

Quinqueloculina parkeri (H. B. Brady).

"Quinqueloculina with oblique ridges," Parker, Micr. Soc. Trans., London, vol. 6, p. 53, pl. 5, fig. 10, 1858.

Miliolina parkeri H. B. Brady, Micr. Sci. Quart. Journ., vol. 21, p. 46, 1881, Rep. Voy. Challenger, Zoology, vol. 9. p. 177, pl. 7, fig. 14, 1884.

Quinqueloculina parkeri Cushman, U. S. Nat. Mus., Bull. 71, pt. 6, p. 50, pl. 15, fig. 3, 1917; Carnegie Inst. Wash., Publ. 342, p. 59, pl. 22, fig. 3, 1924.

This is one of the most common species of this genus in the Tanager collections, occurring at stations 1, 3, 4, 9, 16, 17, 20, 23, 24, 31, and 33. It is a characteristic Pacific species. It has a wide distribution from the Kerimba Archipelago to Hawaii and south to Australia.

Quinqueloculina vulgaris d'Orbigny.

There are numerous specimens, from stations 1, 3, 6, 17, 25, 26, 31, and 33, of a smooth Quinqueloculina, which in general resemble those which I have figured from the Philippines (U. S. Nat. Mus., Bull. 100, vol. 4, pl. 87, figs. 1*a-c,* 1921), and which I have also had from Samoa.

Quinqueloculina bradyana Cushman.

Miliolina undosa H. B. Brady (not *Quinqueloculina undosa* Karrer), Rept. Voy. Challenger, Zoology, vol. 9, p. 176, pl. 6, figs. 6-8, 1884.

Quinqueloculina bradyana Cushman, U. S. Nat. Mus., Bull. 71, pt. 6, p. 52, pl. 18, fig. 2, 1917; Bull. 100, vol. 4, p. 432, 1921.

This seems to be a typically Indo-Pacific species known from the Philippines at various stations, and occurring in the Tanager collections at stations 1, 2, 8, 16, 18, 24, and 33. I had the species originally from two *Nero* stations, off the Hawaiian islands. It did not occur, however, at Samoa. Brady records it from the South Pacific.

Quinqueloculina alveoliniformis (H. B. Brady).

Miliolina alveoliniformis H. B. Brady, Micr. Sci. Quart. Journ., vol. 19, p. 268, 1879; Rep. Voy. Challenger, Zoology, vol. 9, p. 181, pl. 8, figs. 15-20, 1884.

Quinqueloculina alveoliniformis Cushman, U. S. Nat. Mus., Bull. 71, pt. 6, p. 43, 1917; Carnegie Inst. Wash., Publ. 342, p. 58, pl. 21, fig. 8, 1924.

The only specimen which can be referred to this species is a very immature one occurring at station 34. Brady records the species from off the coral reefs of Honolulu in 40 fathoms. It is known almost entirely from the Indo-Pacific, although specimens occur in the West Indian region but never develop to the full characters seen in Pacific material.

Quinqueloculina lamarckiana d'Orbigny.

Quinqueloculina lamarckiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, Foraminifères, p. 189, pl. 11, figs. 14, 15, 1839.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 63, 1924.

Characteristic specimens found by the Tanager Expedition at stations 1, 3, 6, 23, 24, 27, 31, and 33. The species is known from both the western Atlantic and the Pacific, from the Philippines, Samoa, and now from the Hawaiian region.

Quinqueloculina cuvieriana d'Orbigny.

Quinqueloculina cuvieriana d'Orbigny, Foraminifères, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, p. 164, pl. 11, figs. 19-21, 1839.—Cushman, U. S. Nat. Mus., Bull. 71, pt. 6, p. 47, pl. 12, fig. 2, 1917.

There are a few specimens from stations 1, 24, 31, and 33, which show the typical secondary costae, which characterize this species.

Quinqueloculina crassa d'Orbigny.

Quinqueloculina crassa d'Orbigny, Ann. Nat. Sci., vol. 7, p. 301, no. 14, 1826.—Terquem, Mèm. Soc. géol. France, ser. 3, vol. 2, Mèm. 3, p. 186, pl. 20 (28), figs. 20, 21, 1882.

There are a few specimens from stations 9, 25, 31, and 33, which are better referred to *Q. crassa* than to the variety *subcuneata*.

Quinqueloculina crassa d'Orbigny, var. **subcuneata** Cushman.

Miliolina crassa Heron-Allen and Earland (in part) (not d'Orbigny), Zool. Soc. London, Trans., vol. 20, p. 572, pl. 42, fig. 41 (not 37-40).

Quinqueloculina crassa d'Orbigny, var. *subcuneata* Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 423, pl. 89, figs. 4*a-c*, 1921; Carnegie Inst. Wash., publ. 342, p. 62, pl. 23, fig. 7, 1924.

A single specimen from Dowsett Reef, 25 fathoms, station 7, seems to be this variety, which is now known to have a wide Indo-Pacific range, in-

cluding the Kerimba Archipelago, the Philippines, Samoa, and the record here given.

Quinqueloculina ferussacii d'Orbigny.

Quinqueloculina ferussacii d'Orbigny, Ann. Sci. Nat., vol. 7, p. 301, no. 18, 1826.—Cushman, U. S. Nat. Mus., Bull. 71, pt. 6, p. 50, pl. 19, figs. 3, 4, 1917; Bull. 100, vol. 4, p. 429, pl. 90, figs. *2a-c*, 1921.

The only specimen of this species in the Tanager collections is from off Necker Island, in 20 fathoms, station 3. It is similar to that figured from the Philippines.

Quinqueloculina bicostata d'Orbigny.

Quinqueloculina bicostata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, p. 195, pl. 12, figs. 8-10, 1839.—Cushman, U. S. Nat. Mus., Bull. 71, pt. 6, p. 47, pl. 13, fig. 1, 1917; Carnegie Inst. Wash., Publ. 342, p. 62, pl. 23, figs. 1, 2, 1924.

The specimens from the Tanager Expedition, stations 6, 8, and 17, add considerably to the range of this species, which is now known from Samoa and from the region between Yokohama and Guam.

Quinqueloculina striata d'Orbigny?

From Dowsett Reef, 19 fathoms, station 10, there are two specimens which are similar to the form already recorded from Samoa, the Hawaiian islands, and by Heron-Allen and Earland from the Kerimba Archipelago. There is somewhat of a question as to the species being the same as *Q. striata* d'Orbigny, to which it has been referred.

Quinqueloculina bicarinata d'Orbigny.

Quinqueloculina bicarinata d'Orbigny, Ann. Sci. Nat., vol. 7, p. 302, no. 35, 1826.—Terquem, Mèm. Soc. géol. France, ser. 3, vol. 1, pl. 7 (12), figs. *10a-c*, 1878.—Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 428, pl. 86, figs. 2, 3; pl. 100, fig. 7, 1921.

In the Philippine region this is a very abundant species, being characteristic of shallow water among coral reefs. The only station for it in the Tanager collections is off Midway Island, 38 fathoms, station 26.

Quinqueloculina schauinslandi (Rhumbler).

Miliolina schauinslandi Rhumbler, Zool. Jahrb., vol. 24, p. 41, pl. 3, figs. 20, 21, 1906.
Quinqueloculina schauinslandi Cushman, U. S. Nat. Mus., Bull. 71, pt. 6, p. 56, pl. 8, figs. 7, 8, 1917 (after Rhumbler).—Heron-Allen and Earland, Linn. Soc. Journ. Zool., vol. 35, p. 601, pl. 35, figs. 2-5, 1924.

Rhumbler originally described this species from Laysan as rare; Heron-Allen and Earland record it from Lord Howe Island; I have a fragmentary specimen from Laysan, station 16, and another one from Ocean Island, station 33, which although incomplete shows the characteristic early portion of part of one of the irregular chambers. These seem to be the only records for the species.

Massilina annectens Schlumberger.

Massilina annectens Schlumberger, Mèm. Soc. Zool. France, p. 220, text figs. 35-37, pl. 3, figs. 77-79, 1893.—Cushman, U. S. Nat. Mus., Bull. 71, pt. 6, p. 57, pl. 20, fig. 3, 1917.

There are several specimens from the Tanager collections, stations 16, 24, and 33, which may be referred to this species. I have recorded this species previously from *Nero* station 2039, in 24 fathoms, off the Hawaiian islands.

Hauerina ornatissima (Karrer).

Quinqueloculina ornatissima Karrer, Sitz. Akad. Wiss. Wien, vol. 58, p. 151, pl. 3, fig. 2, 1868.

Hauerina ornatissima H. B. Brady, Quart. Journ. Micr. Sci., vol. 16, p. 406, 1876; Rep. Voy. Challenger, Zoology, vol. 9, p. 192, pl. 7, figs. 15-22, 1884.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 67, pl. 24, figs. 7-9, 1924.

A single specimen occurred at station 25. This species is known almost entirely from shallow water of the Indo-Pacific. I have had a few specimens from the West Indian region, also among coral reefs. It occurs in the Pliocene of Florida, and was originally described by Karrer from the Miocene of Kostej in the Banat. This gives a rather interesting range, including both recent and fossil material.

Hauerina bradyi Cushman.

Hauerina compressa H. B. Brady (not *H. compressa* d'Orbigny), Rep. Voy. Challenger, Zoology, vol. 9, p. 190, pl. 11, figs. 12, 13, 1884.

Hauerina bradyi Cushman, U. S. Nat. Mus., Bull. 71, pt. 6, p. 62, pl. 23, fig. 2, 1917; Bull. 100, vol. 4, p. 450, 1921.

Rare specimens occurred at stations 16, 31, and 33. Rhumbler has previously recorded it from Laysan and I had it from "Nero" stations in 55 and 22 fathoms off the Hawaiian islands. It is also known from the Kerimba Archipelago and the other scattered stations in the Indo-Pacific.

Hauerina pacifica Cushman.

Hauerina pacifica Cushman, U. S. Nat. Mus., Bull. 71, p. 64, pl. 21, fig. 2, 1917.

The types of this species were described from off the Hawaiian islands from "Nero" stations in 21 to 33 fathoms. It has not been met with since, and it is interesting, therefore, to find that this is the most common species of the genus in the Tanager collections, occurring at stations 3, 6, 9, 14, 16, 24, and 31. It may be a species localized in this general Hawaiian region.

Triloculina circularis Bornemann.

Triloculina circularis Bornemann, Zeitschr. deutsch. geol. Ges., vol. 7, p. 349, pl. 19, fig. 4, 1855.—Cushman, Carnegie Inst. Wash., Publ. 342, p. 69, pl. 25, figs. 5, 6, 1924.

This species occurs at stations 1, 3, 6, 16, 24, 27, and 31, but except for one in shallow water at Laysan, station 16, it is not common.

Triloculina bertheliniana (H. B. Brady).

Miliolina bertheliniana H. B. Brady, Rept. Voy. Challenger, Zoology, vol. 9, p. 166, pl. 114, fig. 2, 1884.

Triloculina bertheliniana Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 457, 1921.

From the records, this seems to be limited to the Indo-Pacific. Almost all the records are from shallow water. Single specimens occurred at station 6, ten miles west of Gardner Island, and station 33, off Ocean Island. They had the characteristic reticulate ornamentation.

Triloculina linneiana d'Orbigny.

Triloculina linneiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, Foraminifères, p. 153, pl. 9, figs. 11, 13, 1839.—Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 463, 1921.

This species was originally described by d'Orbigny from shore sands of the West Indies, where it is a characteristic species. It is recorded by Heron-Allen and Earland from the Kerimba Archipelago, and is known from numerous other stations in the Indo-Pacific region. I have previously had it from several stations off the Hawaiian islands, and found it in shore sand from Midway Island. It was procured at numerous stations on the Tanager Expedition: 4, 23, 24, 27, 28, 31, and 33. That this species was not found in the rather rich collections from Samoa is most interesting.

Biloculina denticulata (H. B. Brady).

Biloculina ringens Lamarck, var. *denticulata* H. B. Brady, Rept. Voy. Challenger, Zoology, vol. 9, p. 143, pl. 3, figs. 4, 5, 1884.

Biloculina denticulata Cushman, U. S. Nat. Mus., Bull. 71, pt. 6, p. 80, pl. 33, fig. 1; Carnegie Inst. Wash., Publ. 342, p. 70, 1924.

There are single specimens from two Tanager stations; Midway Island, station 25, and Ocean Island, station 33.

Biloculina denticulata (H. B. Brady), var. **striolata** (H. B. Brady).

Biloculina ringens (Lamarck), var. *striolata* H. B. Brady, Rep. Voy. Challenger, Zoology, vol. 9, p. 143, pl. 3, figs. 7, 8, 1884.

Biloculina denticulata (H. B. Brady), var. *striolata* Cushman, U. S. Nat. Mus., Bull. 71, pt. 6, p. 80, pl. 33, figs. 2, 3, 1917; Carnegie Inst. Wash., Publ. 342, p. 70, 1924.

The only record for this species is a single specimen from station 17, off Lisiansky Island.

Peneroplis pertusus (Forskål).

Nautilus pertusus Forskål, Descr. Anim., p. 125, no. 65, 1775.

Peneroplis pertusus Jones, Parker, and H. B. Brady, Foram. Crag., p. 19, 1865.—H. B. Brady, Rep. Voy. Challenger, Zoology, vol. 9, p. 204, pl. 13, figs. 16, 17, 1884.—Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 481, 1921.

This species occurs at stations 1, 2, 4, 5, 12, and 34, and is common at stations 16, 24, and 31.

Peneroplis cylindraceus Lamarck.

Nautilus acicularis Batsch, Conch. des Seesandes, p. 4, pl. 6, figs. 16*a*, *b*, 1791.
Peneroplis cylindraceus H. B. Brady, Rep. Voy. Challenger, Zoology, vol. 9, p. 205, pl. 13, figs. 20, 21, 1884.—Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 483, 1921.

A single specimen of a very slender elongate form occurs in the material from station 34, Johnston Island.

Peneroplis arietinus (Batsch).

Nautilus (*Lituus*) *arietinus* (in part) Batsch, Conch. des Seesandes, p. 4, pl. 6, fig. 15*c*, 1791.
Peneroplis arietinus Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, p. 26, pl. 1, fig. 18, 1865.—Cushman, U. S. Nat. Mus., Bull. 100, vol 4, p. 482, 1921.

At Ocean Island, station 33, this species seems to take the place entirely of *P. pertusus,* which is common elsewhere. A single specimen also occurred at station 24, Pearl and Hermes Reef.

None of the very broad forms usually referred to *P. planatus* occurred in any of the material, although I have had specimens of this species from off the Hawaiian islands in other material that I have had previously.

Orbitolites marginalis (Lamarck).

Orbulites marginalis Lamarck, Hist. Nat. Anim. sans Vert., vol. 2, p. 196, no. 1, 1816.
Orbitolites marginalis Carpenter, Philos. Trans., p. 192, pl. 9, figs. 1-4, 1856.—Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 484, 1921.

This is the least common of the species of this genus in the Tanager collections, occurring at stations 15, 16, 25, 27, and 33. I have had it previously from several stations off the Hawaiian islands in comparatively shallow water.

Orbitolites duplex Carpenter.

Orbitolites, duplex type, Carpenter, Philos. Trans., p. 120, pl. 5, fig. 10; pl. 9, fig. 10, 1856.
Orbitolites duplex Carpenter, Orbitolites, Rep. Challenger, p. 25, pl. 3, figs. 8-14, 1883.—Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 485, 1921.

This is by far the most common species of the Miliolidae in the region covered by the Tanager Expedition and occurs at stations 1, 2, 3, 8, 10, 16, 17, 19, 23, 24, 25, 26, 27, 28, 29, 31, 33, and 34. This corresponds with the conditions found at Samoa, where it is the characteristic species of the reefs.

Orbitolites complanata Lamarck.

Orbitolites complanata Lamarck, Syst. Anim. sans Vert., p. 376, 1801.—H. B. Brady, Rep. Voy. Challenger, Zoology, vol. 9, p. 218, pl. 16, figs. 1-6; pl. 17, figs. 1-6, 1884.—Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 486, 1921.

Specimens referred to this species occurred at station 33, Ocean Island, and station 24, Pearl and Hermes Reef. They have a peculiar surface condition in which a secondary series of chambers are piled up on the flat surfaces of the test.

Alveolina melo (Fichtel and Moll).

Nautilus melo Fichtel and Moll, Test. Micr., p. 118, pl. 24, 1803.

Alveolina melo d'Orbigny, Ann. Sci. Nat., vol. 7, p. 306, no. 2, 1826.—H. B. Brady, Rep. Voy. Challenger, Zoology, vol. 9, p. 223, pl. 17, figs. 13-15, 1884.—Cushman, U. S. Nat. Mus., Bull. 71, pt. 6, p. 97, pl. 39, fig. 4, 1917.

This species has occurred at stations 2, 3, 6, 23, and 33, but usually in not any considerable numbers. Brady recorded it from off the Hawaiian islands, and it is known from other localities in the Indo-Pacific. I did not, however, find the species in the Philippine region or at Samoa.

Alveolina boscii (Defrance)?

At five stations in the Tanager collections, 1, 2, 6, 8, and 27, there are specimens which do not have the typical rounded form of *A. melo*. In only one case, however, does the elongation become very marked. It may be noted that this elongate form occurs with the rounded one only at the single station, off Gardner Island. In this connection it is interesting to note that Heron-Allen and Earland record two distinct forms, which they refer to *A. melo* in their Kerimba Archipelago material; one which was more frequent and typical being spherical, the other obtusely elliptical. This may show a similar condition to that which obtains in the Tanager material.

A, AXIOPSIS (PARAXIOPSIS) JOHNSTONI, HOLOTYPE; *B*, CRYPTOCHIRUS CRESCENTUS, TYPE SPECIMEN; *C*, PIT IN CORAL, PAVONA DUERDENI, INHABITED BY CRYPTOCHIRUS CRESCENTUS; *D*, CRYPTOCHIRUS CORALLIODYTES HELLER, WAKE ISLAND SPECIMEN, DORSAL VIEW; *E*, CRYPTOCHIRUS CORALLIODYTES HELLER, WAKE ISLAND SPECIMEN, SIDE VIEW; *F*, PIT IN CORAL INHABITED BY CRYPTOCHIRUS CORALLIODYTES HELLER, WAKE ISLAND SPECIMEN.

A, DARDANUS SANGUINOCARPUS, TYPE SPECIMEN; *B*, DARDANUS SULCATUS, HOLOTYPE; *C*, SYMPAGURUS PACIFICUS, HOLOTYPE.

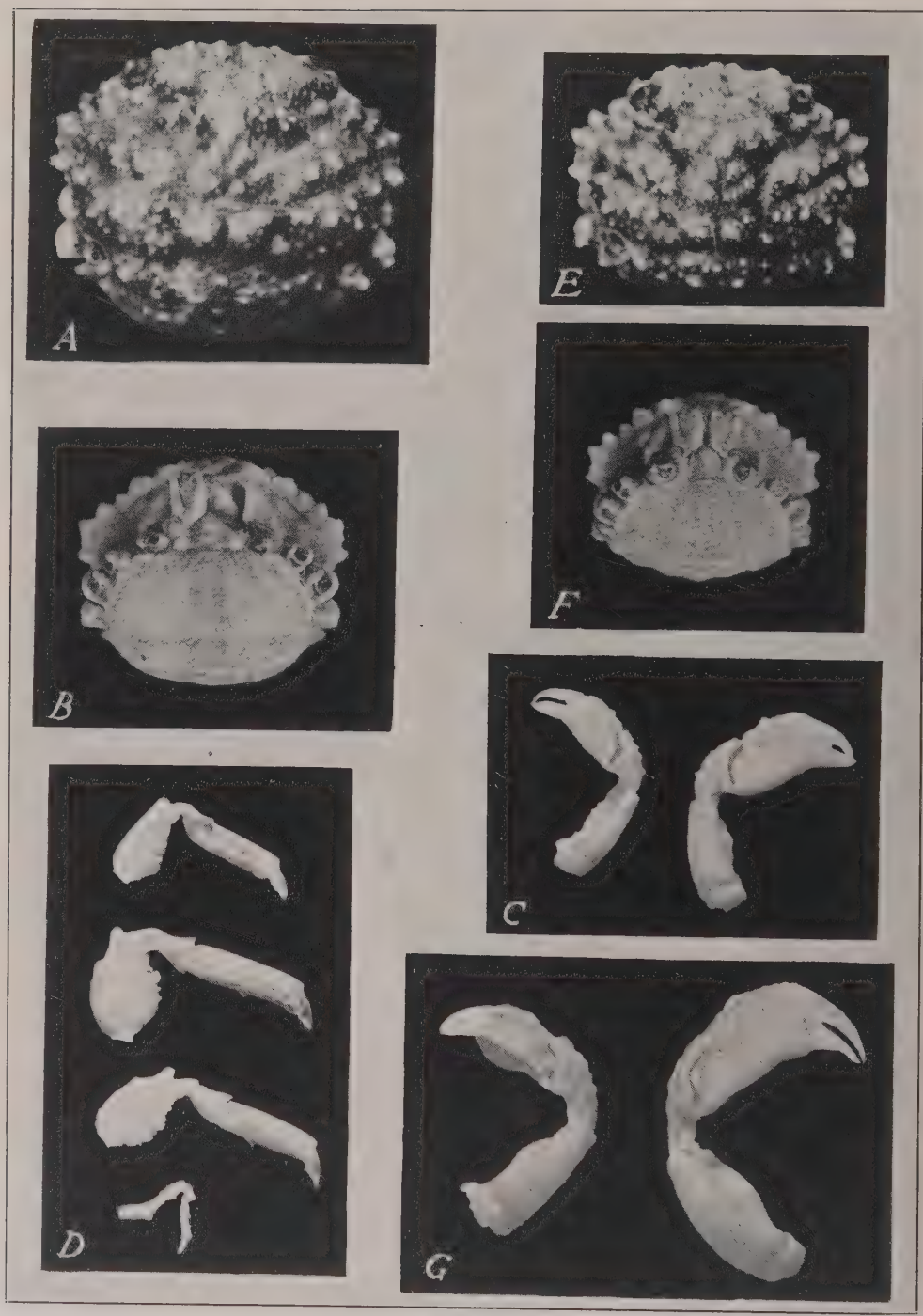
A

B

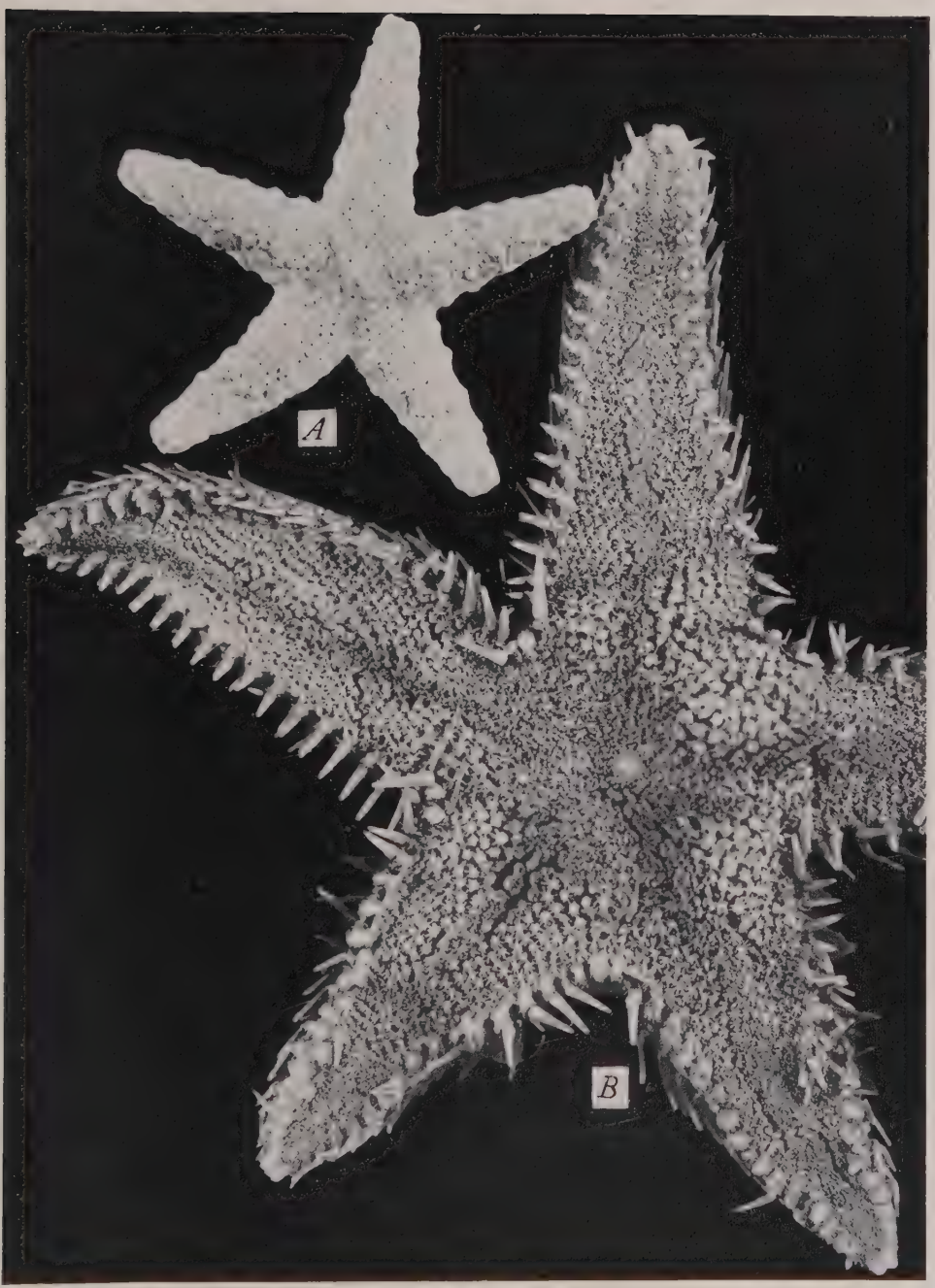
C

D

A, THALAMITA WAKENSIS, HOLOTYPE; *B*, EUXANTHUS MINUTUS, TYPE SPECIMEN, *C*, CHLORODIELLA ASPER, TYPE SPECIMEN (♀); *D*, CHLORODIELLA ASPER (♂).



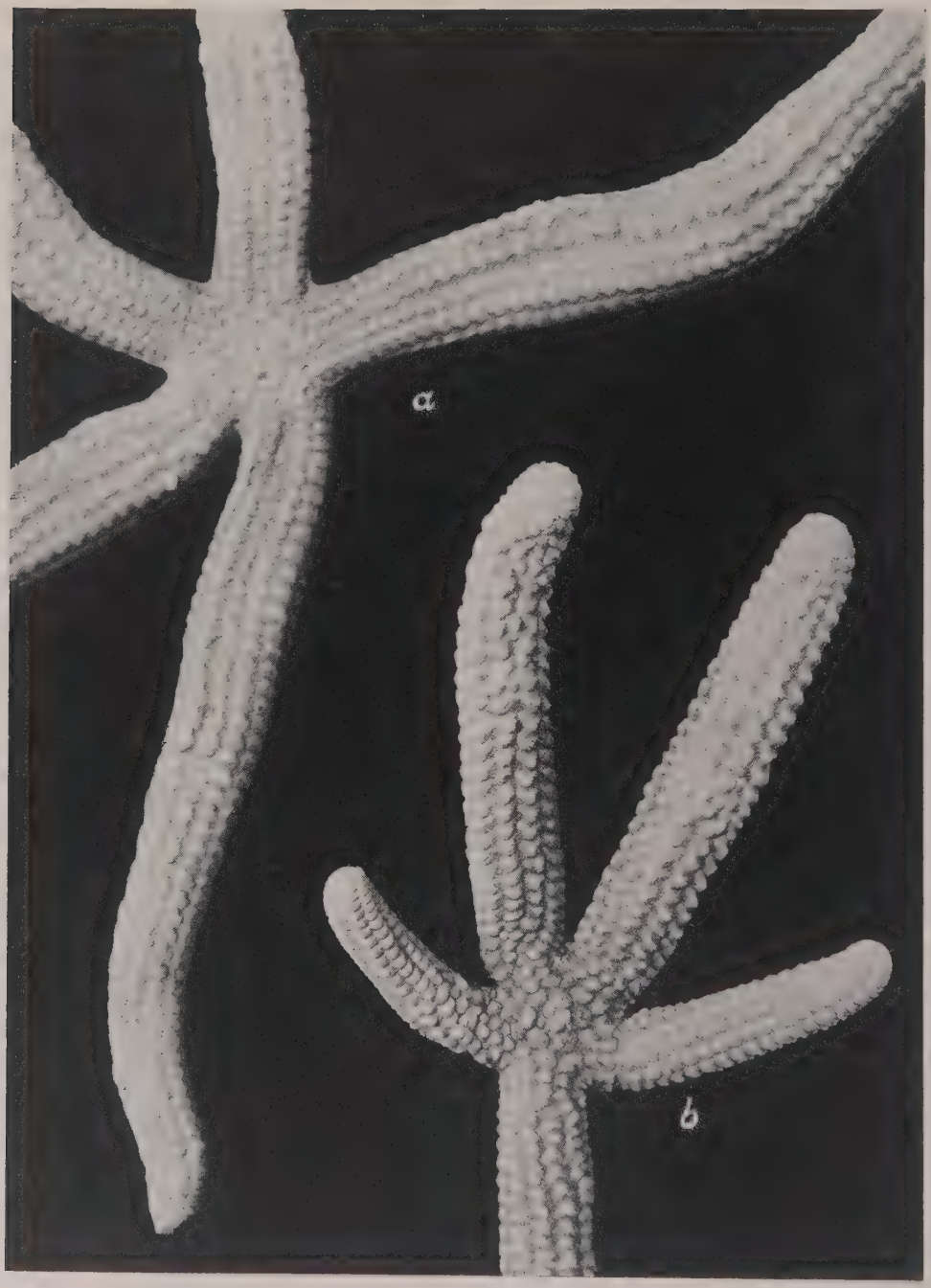
A, PALICUS TUBERCULATUS, TYPE SPECIMEN, DORSAL SURFACE OF CARAPACE; *B*, VENTRAL SURFACE OF SAME; *C*, PALICUS TUBERCULATUS, TYPE SPECIMEN, CHELIPEDS; *D*, PALICUS TUBERCULATUS, TYPE SPECIMEN, FOUR WALKING LEGS; *E*, PALICUS TUBERCULATUS (♂), DORSAL SURFACE OF CARAPACE; *F*, VENTRAL SURFACE OF SAME; *G*, PALICUS TUBERCULATUS (♂), CHELIPEDS.



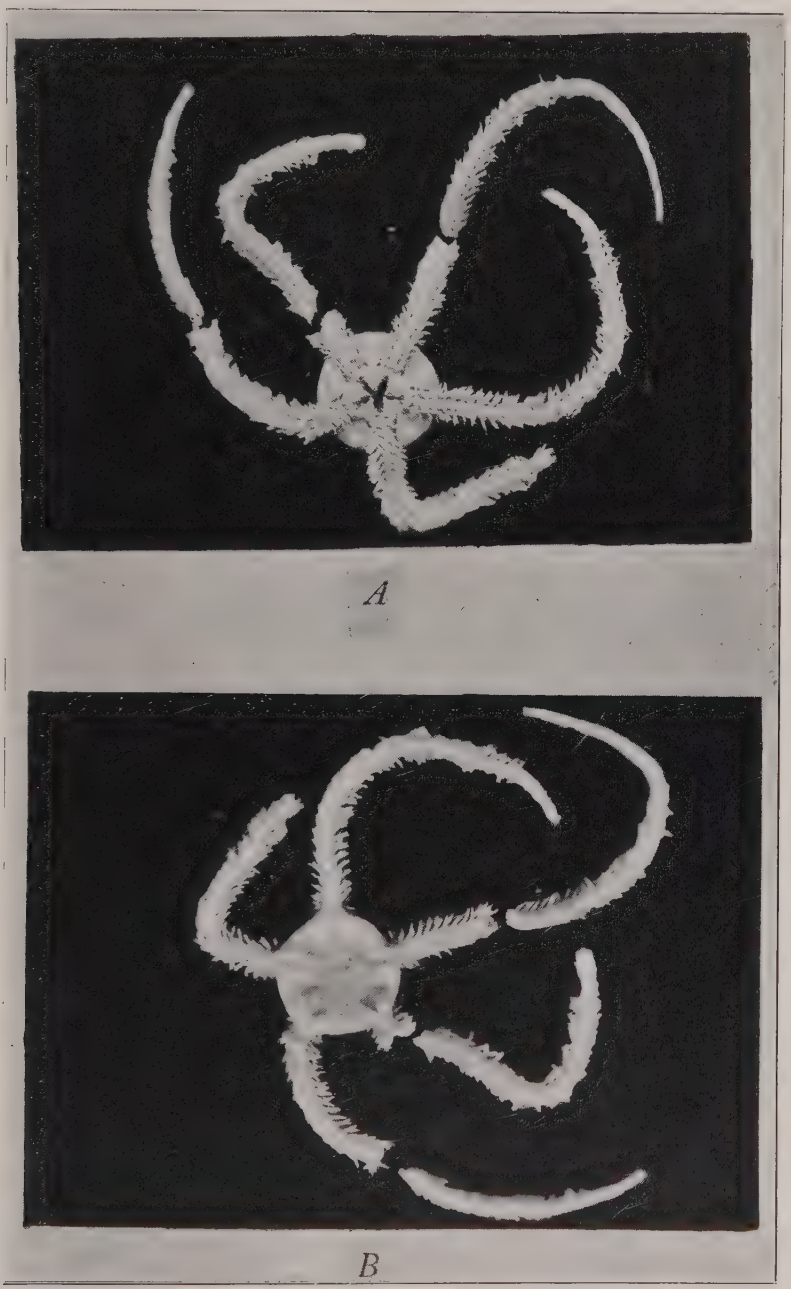
A, FERDINA CANCELLATA TYLATA, TYPE; *B*, ASTROPECTEN TRISERIATUS MYOBRACHIUS, TYPE, ABACTINAL ASPECT.

CULCITA NOVAEGUINEAE FORMA ARENOSA, PEARL HARBOR, ABACTINAL VIEW.

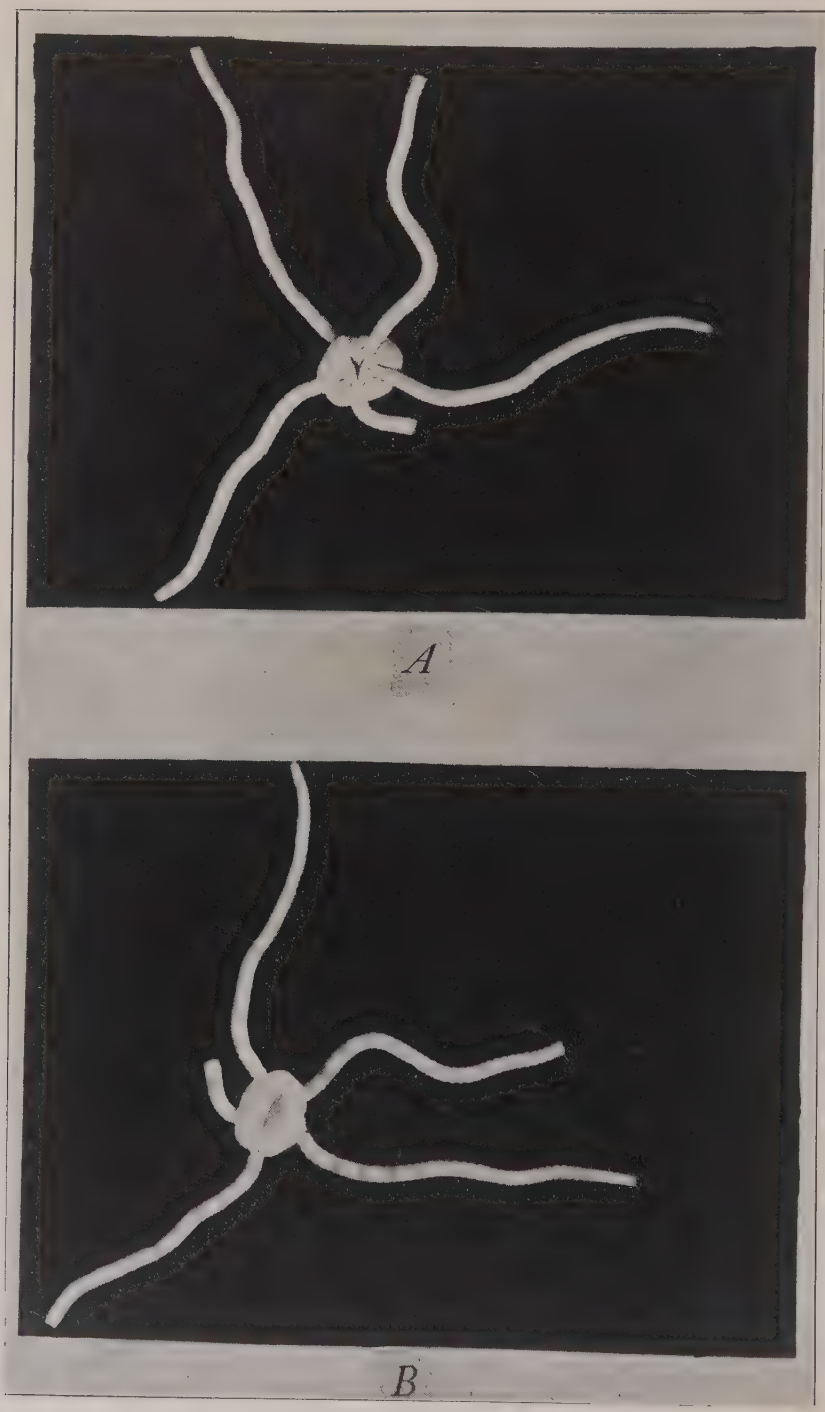
CULCITA NOVAEGUINEAE FORMA NESIOTIS, TYPE, ABACTINAL VIEW.



a, LEIASTER LEACHII HAWAIIENSIS, TYPE, ARACTINAL VIEW; *b*, DACTYLOSASTER CYLINDRICUS PACIFICUS, TYPE, ABACTINAL VIEW.



OPHIOLOGIMUS QUADRISPINUS H. L. C. X 2: *A*, ORAL SURFACE; *B*, ABORAL SURFACE.



OPHIARACHNELLA PARVISPINA H. L. C. X 2: *A*, ORAL SURFACE; *B*, ABORAL SURFACE.

CLYPEASTER EURYPETALUS H. C. L. X 3/7: *A*, ABORAL SURFACE; *B*, ORAL SURFACE; *C*, SEEN FROM THE LEFT HAND SIDE.

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